DICTIONARY OF PRACTICAL SURGERY

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DICTIONARY

OF

PRACTICAL SURGERY

BY

VARIOUS BRITISH HOSPITAL SURGEONS

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only. The patient's neck should be kept slightly flexed by means of pillows and sand-bags. A long piece of calico bandage should be placed with the centre over the vertex, and the two ends hanging down by the side of the neck and in front of the thorax. A band of calico should now be placed round the head to secure the central portion of the bandage, while the two extremities are firmly attached to the front of a belt of calico placed round the thorax. It may be desirable to substitute strapping for the calico bands, in order to obtain greater security. A light dressing of carbolic gauze should be placed in front of the wound, and secured there by a few loose turns of bandage. This will filter and to some extent purify the air. The patient should be constantly watched by an attendant, to prevent a repetition of the suicidal attempt, and to give warning of the first signs of reactionary hæmorrhage. Later on, the wound is apt to become very foul, and it will be necessary to apply iodoform powder or some other antiseptic to cleanse the parts. Otherwise the fetid discharges may pass into the lungs and set up pneumonia. Abscesses which form should be at once opened, and the ready discharge of their contents should be promoted by drainage-tubes. Quinine may be required to combat the tendency to septicæmia. Fistulous openings into the trachea or œsophagus may persist, and they will have to be closed by operation when the patient has recovered from the more immediate effects of the injury.

Burns and Scalds.—The exposed position of the throat renders it liable to severe injuries of this description. When confined to this region the lesion is not dangerous, but it often gives rise to great deformity, such as the dragging down of the lower lip with the exposure of its mucous surface, and it may even distort the inferior maxilla and evert the lower teeth. Great care will therefore be required, while the granulating surfaces are healing, to resist this tendency, by maintaining the head and neck in the position of complete extension. *See* Burns; Cicatrices, Pathological Conditions of.

N. Davies-Colley.

THROMBOSIS, the formation of clot within a blood-vessel, the lumen of which is thereby more or less completely obstructed.

Thrombosis is a necessary factor in the healing of injured blood-vessels, the primary change in cases of so-called adhesive phlebitis, and the most frequent source of emboli. Thrombi are met with both in veins and arteries, also commonly within the heart, developed on the valves (vegetations), between the muscular trabeculæ or in the auricular appendages. They may be parietal and partially obstruct the circulation, or may completely occlude the vessel in which they are situated. They are usually divided into primary or autocthonous, and secondary thrombi. The former term is applied to the clot deposited at the immediate seat of the disease or injury; the latter to that developed later, stretching to collateral branches, or to that formed around an embolus or foreign body which may have gained entrance to the circulation.

Circumstances under which Thrombosis may occur.—The process depends on the subjection of the blood to such conditions as prevent the maintenance of its fluid state. The coagulation of the blood depends on the union of the two substances fibrinogen and paraglobulin in the presence of the so-called fibrin ferment. Fibrinogen is a constituent of blood-serum; paraglobulin is contained partly in the serum, mainly in the white blood-cells, and these latter are the sole source of the fibrin ferment. This union is promoted by any change from the healthy state in the endothelial lining, or by interruption of the circulatory flow. To the existence of one or both of these morbid conditions thrombosis is to be referred.

Causes of Thrombosis.— 1. Increased intravascular resistance, such as may be caused by pressure upon veins by tumours, or by the ligature of a vessel. In the veins in such cases, as a result of the slowing of and resistance to the circulation, the valves stand open and the blood stagnates behind them; hence this is the common starting-place of thrombi.

2. Slowing of the blood-current as a result of abnormal dilatation, seen in phlebectasis and aneurism.

3. General weakness of the circulation, as seen after fevers or in cardiac disease.

4. Trauma, with varying amount of injury to arterial or venous wall.

5. The entrance of foreign bodies, as in transfixion of a vein by a needle or ligature during an operation on the neighbouring artery; coagulating fluids injected.

6. Disease of the vascular wall—(*a*) acute, as seen in ulcerative endocarditis or endoarteritis; (*b*) chronic, as in atheromatous disease.

7. Extension of inflammation from neighbouring tissues, or pressure by inflammatory exudation.

8. The entrance of specific organisms.

Structure of Thrombi and subsequent Changes observed.—Thrombi may be white, red, or mixed. The large majority are of the white or mixed variety, consisting almost entirely of white cells in a fibrinous meshwork arranged in concentric laminæ; the mixed thrombi contain a variable proportion of red discs also. They are developed as long as any circulatory flow exists; the red only when complete stagnation exists, in addition to defective nutrition of the vessel-wall. The changes which take place in thrombi, subsequently to their deposition, are of a twofold character—degenerative or towards organisation.

A. *Degenerative Changes.*—1. The clot may simply dry up and shrink, eventually undergoing fatty or calcareous degeneration. 2. Simple regressive changes may start from the centre, puriform degeneration taking place. If such a clot be cut across, the central portion is found in a semi-fluid condition, the fluid consisting of a varying quantity of white blood-cells, broken-down red discs, blood-pigment, and granular detritus. The process may be followed by the detachment of irritant emboli. 3. Yellow purulent softening. The change here is a septic one, the broken-down clot being loaded with septic organisms. Emboli from such a source infallibly give rise to metastatic deposits. This change occurs in connection with septic inflammation around the vein.

B. *Organisation.*—In this case a more or less permanent plug is developed. The first change is the migration of leucocytes into the recent clot, followed by its vascularisation. The origin of the active cell-elements has been much disputed; the larger number are no doubt derived from the white blood-cells furnished by the vasa vasorum, but two other sources are described—(1) the white blood-cells contained in the original clot, and (2) endothelial proliferation. The question as to the first is of little moment, as the number of cells is unimportant, but the latter is said by good observers to be the most abundant. Although denied, it has been in no sense disproved, and when the continuity of the lining membrane of blood-vessels, lymphatics, and connective-tissue interspaces is remembered, it cannot be regarded as improbable. In the presence of the new cell-elements the granular fibrinous meshwork disappears, the red blood-discs break down, and the pigment becomes absorbed. The new cells take on the spindle form, new blood-vessels develop, clefts in the clot lined with spindle-cells forming connections with the vasa vasorum, and young connective tissue is the result. In favourable cases, vascularisation is apparent at the end of six to seven days; in others it may not be complete for months. Further changes may be simply cicatricial, or canalisation may follow.

The immediate results of thrombosis are not so serious as those of embolism, on account of the gradual nature of the process. Their gravity depends on the size and situation of the vessel affected. General cardiac thrombosis is usually the precursor of death; the parietal vegetations, on the other hand, are chiefly dangerous as the source of emboli. Arterial thrombosis gives rise to primary anæmia and interference with function, which may be followed by congestion due to regressive venous flow from removal of *vis-à-tergo*. Venous thrombosis in the limbs is followed by œdema, which, if permanent, leads to a general condition of lowered vitality and chronic inflammation. If very extensive, gangrene may result. In the organs, temporary interference with function is the usual result, the collateral circulation even in the case of the portal vein being generally sufficient to allow of recovery. The relation of thrombosis to embolism is considered separately; also the local changes in the vessel wall. *See* Embolism.

Symptoms.—The general symptoms will depend simply on altered function, if an organ be affected. The local signs are the palpable presence of a clot, if the vessel be superficial or tangible; otherwise, the presence of anæmia or congestion and œdema.

Treatment.—This consists in the adoption of means calculated to facilitate the circulation in its embarrassed condition, such as rest, the raising of an extremity, the employment of moderate pressure, and, in certain cases, the employment of mild counter-irritants to promote the absorption of clot. The important prophylactic point of avoiding disturbance of recent clot, has been adverted to in the article on Embolism.

G. H. Makins.

THUMB, Amputation of the. *See* Fingers, Amputations of the.

THUMB, Dislocation of the. *See* Hand, Dislocations of Bones of the.

THYROID GLAND, Diseases of the. *Preliminary Remarks.*—Considering the new light which has been recently thrown upon the unsettled question of the physiology of the thyroid body, and the great importance of this question as regards surgical

interference with that organ, it appears desirable to state briefly, before its diseases are discussed, the results of the latest physiological and pathological observations elucidating the consequences arising, to the animal economy, from loss of the function of the thyroid body.

Up to a very recent period it had been, roughly speaking, surmised that the thyroid had no functions at all, though it had been known for centuries that its absence or degeneration was very often connected with cretinism; that both cretinism and goître were endemic in the same localities; and that goîtrous parents often produced cretinous offspring.

In 1874 Sir William Gull described a cretinoid condition supervening in adult women, and characterised by swelling of the body, a particular flush of the cheek, languor of movements and thought, thickness of speech, general placidity of temper interrupted by occasional nerve-storms. Sir William declared himself unable to pronounce definitely about the state of the thyroid in these cases.

Four years later, Dr. Ord, who had the opportunity of making a post-mortem examination in a case of this sort, and who found overgrowth of connective tissue, the interstitial cement of which yielded enormous quantities of mucin in all parts of the body, gave to this condition the name of *myxœdema*. This author first drew attention to the diminution of the thyroid body, associated with an almost complete annihilation of the proper gland-tissue by the mucoid infiltration.

This diminution, sometimes amounting almost to a disappearance of the gland, was noted by many later observers. Still, it was generally supposed to be a result of the pathological process, not a working factor in the production of the other phenomena. Matters remained in this state up to the beginning of 1883. In that year, Professor Kocher of Berne described a curious collection of symptoms, which he had noted as gradually supervening in all his cases of *total* removal of goître. Only those of his patients in whom there were either accessory thyroid bodies, or in whom a part of the enlarged gland had been intentionally or inadvertently left behind, remained free from these symptoms. Similar observations had been made by the Messrs. Reverdin of Geneva. On the other hand, it is but fair to state that Professor Billroth of Vienna, who has extirpated more goîtres than any living surgeon, states that he has never seen unusual symptoms develop after the operation. Kocher gave to the state of things developing after the total removal of goîtres (goître is called in German scientific language 'struma'), the name of 'cachexia strumipriva.' The writer of this article, when reading Kocher's paper, came to the conclusion that myxœdema and cachexia strumipriva were practically identical; that the cause of both was loss of the function of the thyroid body, and that the only symptom peculiar to the latter, when total removal of a goître had been practised in *young* individuals—viz. arrest of the growth of the body—was undoubtedly to be explained by the fact that (in these cases) the loss of the thyroid made itself felt before the evolution of the body had been completed, whilst myxœdema, on the other hand, was essentially a disease of adult life.

It is, indeed, possible to go one step farther, and to account for endemic cretinism by assuming that it is due to loss of function of the thyroid body, from conditions occurring during intra-uterine life. The writer, in fact, when communicating Professor Kocher's observations to the Clinical Society in 1883, ventured to enunciate the proposition that cretinism, myxœdema, and cachexia strumipriva were merely different phases of one and the same condition, and due to one and the same cause—viz. to arrest of the function of the thyroid gland. This proposition soon found corroboration by the publication of a very remarkable case of total extirpation of the thyroid gland, performed in 1867 on a bright, well-developed boy, then ten years old. Professor Paul Bruns of Tübingen, who saw the patient seventeen years later, reports that he had not merely developed all the usual symptoms of myxœdema, but that the growth of the trunk and of the limbs had become entirely stunted, whilst the head alone had continued to grow; that the patient's mental faculties had undergone not merely arrest but even a retrograde change, and that, in fact, the lad had become a dwarfy cretin.

A further and still more important corroboration of the writer's proposition has quite recently been furnished by Mr. Victor Horsley, who has succeeded in producing myxœdema in the monkey by extirpating the thyroid gland, and who, from his anatomical, chemical, and experimental researches, comes to the following conclusions:—

1. The thyroid body appears to consist of two portions: (*a*) a glandular, consisting of highly vascular acini, which excrete a

mucoid substance—a mucin-excreting portion (?); and (*b*) highly vascular lymphoid nodules—hæmatogenous function (?).

2. Excision of the gland is followed by a great increase in the quantity of mucin found in the tissues, an increased activity of the mucin-producing glands, and a change in function of other non-muciparous glands, whereby they become mucin-formers.

3. Profound changes also ensue in the blood. The red blood-corpuscles are decreased with leucocytosis, the coagulability is lessened, and its albumens are altered in character.

4. Nerve-symptoms also appear, changes taking place in the lowest motor centres, causing rigidity, tremors, and paresis. Changes occur in the higher psychological centres, whereby imbecility and cretinism occur, followed by death, which usually occurs in a condition of coma.

Reviewing these facts, Mr. Horsley points out that it is clearly shown that removal or alteration of the function of the thyroid is the cause of the general bodily condition. Whether such changes may be due to the intermediate action of the vaso-motor or of a trophic centre, it is impossible to say. When it is remembered that the thyroid body contains a mucinoid material, and that after its removal mucin appears largely in all the tissues, it becomes a question whether the thyroid may not be an excreting gland, the removal of which, as is usual in analogous cases, induces death. In support of this, it is urged that removal of one lobe causes hypertrophy of the other. If, subsequently, the second lobe be removed, myxœdematous symptoms arise.

Thus the question stands at the present moment. The limited space allotted to the writer does not permit him to discuss the results and views of other observers (Schiff, Zesas, Wagner, Tauber, Credé, Hadden, Sanquirico, Canalis, and others).

Inflammation. — *Causes.* — Inflammation of the thyroid gland (thyroiditis) may be of three types: idiopathic, traumatic, metastatic. It may be mentioned here, at once, that inflammation of a previously healthy thyroid gland is altogether rare, and that it occurs much more frequently in cases of enlarged glands (goîtres), when all the symptoms hereinafter described are present, as a rule, in still more aggravated form. The idiopathic form is very rare, and its etiology obscure. It is generally attributed to catching cold. Traumatic inflammation may be caused by any violent injury to the gland. Metastatic thyroiditis may occur in the course of or subsequently to typhoid fever, pyæmia, or puerperal fever; in some rare cases it has followed pneumonia and bronchitis; once it has been observed to alternate with orchitis.

Pathology.—All forms of acute thyroiditis are characterised by the usual changes occurring in inflammations: congestion of the vessels, exudation of serum, emigration of leucocytes. The inflammation may end either in resolution, or in suppuration, or in gangrene. Resolution not rarely occurs in acute idiopathic thyroiditis. Suppuration is the most frequent end of all forms of inflammation of the thyroid gland. Sometimes several abscesses are formed, which generally point outwards, or more rarely perforate into the mediastinum, the air-passages, or the œsophagus. Gangrene is very rare; it may occur when suppuration extends to the connective-tissue capsule of the thyroid gland, and causes phlegmonous inflammation of the fasciæ of the neck.

Symptoms.—Febrile symptoms, sometimes rigors, first occur. There are vague pains about the face, neck, upper part of the trunk, and occasionally the whole body, associated with a feeling of constriction about the throat, dysphagia, sometimes slight dyspnœa. Soon the gland, and shortly afterwards the whole neck, begins to swell; sometimes the whole gland, in other cases only one lobe is thus affected. The inflamed part projects beyond the generally tumefied neck as an isolated tumour of either firm or more brawny consistence. The veins of the neck are turgid, the inflamed region is very tender to the touch, there is continuous or intermittent pain. Owing to the swelling, the following symptoms may occur: compression of the deeper vessels leads to headache, dulness, giddiness, cyanosis of the face, sometimes to epistaxis; compression of the œsophagus to increased dysphagia; pressure upon the trachea and the motor nerves of the larynx to dyspnœa, often very considerable, sometimes fatal, and to dysphonia. Under these circumstances, patients have been observed to bend the head, by preference, backwards.

If the case tends to resolution, all these symptoms may disappear within a few days or weeks. The occurrence of suppuration, on the other hand, is manifested by continued fever, renewal of the rigors, redness, fluctuation where the skin is red, and finally bursting of the abscesses. In rarer cases, suppuration occurs in more centrally situated parts of the gland, when it may be difficult to detect the exact seat of the abscess, and death may be caused by perfora-

tion into the trachea or the mediastinum. In some cases of metastatic thyroiditis, suppuration may occur in the form of an almost painless, cold abscess.

Diagnosis and Prognosis.—Acute inflammations of the thyroid gland can hardly be mistaken for other affections. The prognosis, unless general septicæmia or pyæmia occurs, or unless—as in the metastatic form—the original disease tends to a fatal issue, is not unfavourable, even if gangrene should occur.

Treatment.—The treatment of all forms of acute thyroiditis must be antiphlogistic. In the first stage, constant applications of ice ought to be made over the inflamed organ; leeches may be applied to the supra-clavicular regions, and local or general venesection may become necessary. If, in spite of these measures, suppuration threatens, warm poultices must be substituted for the ice applications, and, as soon as fluctuation occurs, the abscess or abscesses must be opened by incision under antiseptic precautions, or by means of trocar and canula. In cases of deep-seated abscess, the incision must not be too small, and a drainage-tube had better be inserted. Lücke recommends, in those cases in which the trocar is used, after evacuation of the pus to wash out the cavity with carbolised water and to inject some tincture of iodine, after which the wound is to be closed by plaster.

Goître.—All tumefactions of the thyroid gland not due to inflammatory or malignant diseases, or to the immigration of parasites, are usually comprised under the name of goître.

Goître occurs generally in an endemic form, sometimes epidemically (this especially, though not exclusively, in soldiers whose garrison has been changed to a locality in which the disease is endemic), in other cases sporadically. It may be either congenital or acquired. The latter form is most frequently developed at, or immediately after, the period of puberty. The female sex is much more frequently affected than the male, but it is stated that, in India, both sexes suffer in almost equal proportions.

Goître forms one of the symptoms of the malady known as 'Graves's' or 'Basedow's' disease, or as 'exophthalmic goître,' which is characterised by prominence of the eyeballs, usually a pulsating swelling of the thyroid gland, palpitations of the heart, and general nervous irritability. In localities where goître prevails endemically, the domestic animals are not rarely goîtrous. Geographically, endemic goître may be said to occur mostly in mountainous districts. Thus, according to Lücke's careful compilation, in Europe, the Alps, Pyrenees, Carpathian Mountains, the Black Forest, Thuringia, the Hartz, the Erzgebirge, Riesengebirge; in America, the Cordilleras; in Asia, the Himalayas, are the main localities of endemic goître. On the other hand, there are mountainous districts in which goître is little known, such as the mountains of Sweden and Norway, the Scotch Highlands, the Apennines.

In mountainous regions where goître prevails, deeply cut valleys suffer more than high plateaux. Then, again, whilst large plains are usually free from endemic goître, the affection prevails in some such plains, as in the Rhine Valley, in Silesia, in Northern Italy, in many districts of France, in the Punjaub, and the valley of the Orinoco. It is to be noted that in all the regions just mentioned there are large rivers, often inundating their borders, and marshy low grounds. Low seacoasts are, on the whole, free from goître; but here also there are exceptions, such as the island of Arran and the Azores.

Causes.—The causes of endemic goître are at present still enshrouded in mystery. Of all the numerous theories propounded to explain the endemic occurrence of tumefactions of the thyroid gland, none appears to cover the whole question, though each may claim a certain degree of plausibility. Thus the condition of the atmospheric air (especially a humid climate); impurities of the drinking water (snow water, excess of mineral or of metallic contents, organic impurities, want of bromine, iodine, or carbonic acid); geological conditions of the soil (especially those formations which produce water containing an excess of magnesia); a certain 'goître-miasma,' and individual predisposition (age, sex, heredity, occupation, food, ventilation, and situation of dwellings, &c.), are all accused of producing, alone or conjointly, endemic goître.

In the etiology of sporadic goître, heredity plays the most important *rôle*; next to it, changes in the circulation, arising from the sexual functions of females (menstruation, pregnancy, parturition); finally, all those conditions which favour congestion to the head and stasis in the veins of the neck (carrying of heavy weights on the head, mountain climbing, blowing of trumpets, &c.).

Epidemic goître may be most fitly designated as a quick development of tumefaction of the thyroid gland in a number

of persons, under conditions favouring the development of the endemic form of the disease.

Exophthalmic goître is probably due to an affection of the cervical sympathetic nerve, the swelling of the thyroid gland more especially to paralysis of the vaso-motor branches of the sympathetic, giving rise to chronic hyperæmia of the vessels of the gland, and thus favouring the conditions necessary for the production of goître. This view, however, though probably correct, is not yet definitely proven.

Pathology.—Though, of late, a great many subdivisions of the different forms of goître have been made, notably by Wölfler, based upon well-marked anatomical differences, it will, for practical purposes, suffice to distinguish between three main forms—viz. simple hypertrophy, cystic and fibroid enlargements of the gland. Between these three forms all possible varieties of transition occur. The enlargement may concern the whole gland or only parts of it. Practically, it is important to note that, in cases in which an accessory gland exists, this may either become goîtrous together with the main gland, or even alone. Goître may form very rapidly, or—and this is more usual—very slowly and insensibly.

In all forms of goître, the vessels of the gland, especially the veins, are considerably dilated. Goîtres in which the vascular changes predominate over the parenchymatous have been called 'vascular,' and, if pulsation exists within them, 'aneurismal' goîtres. It is, however, from a practical point of view, as little necessary to describe them as distinctly separate forms, as to look upon the goître of Graves's disease, in which the vascular changes also often play a predominant *rôle*, as an individual and distinct form. In reality, exophthalmic goître may and does occur in any of the three main types just mentioned, though, most frequently, it is the soft parenchymatous form with great vascular dilatation in which it is met with.

Goître may assume enormous dimensions, or its growth may after a time be arrested; sometimes, even spontaneous resolution is said to take place, especially if the individual leaves a goîtrous district, or if he be attacked by an acute febrile disease.

The different forms of goître, as well pointed out by Lücke, whose classical description is mainly followed in this paragraph, generally represent merely different phases of one and the same pathological process. In the simplest forms (parenchymatous or follicular goître), permanent hyperplasia of the follicles is produced by over-nutrition resulting from repeated or constant congestion of the vessels of the gland. The interstitial connective tissue may become atrophied by pressure, whilst the hyperplasic part may be surrounded by a thick connective-tissue capsule. If, on the other hand, the interstitial tissue shares in the process of nutritive irritation, which it generally does in somewhat later stages of parenchymatous goître. it begins to grow exuberantly. Then, the second form of goître, the fibroid, is produced. The fibroid enlargement may be either diffuse or localised. In the former case, the glandular masses appear to be imbedded in very tough bands of fibroid tissue. In the latter case, hard nodules may be found, movable and well isolated from the rest of the gland and from each other. The follicles in these nodules greatly atrophy, and finally only small remnants of them remain, which may undergo cystic degeneration. Sometimes, calcification takes place in very large and very long-standing fibroid goîtres.

Parenchymatous goître frequently degenerates. A rare form of such degeneration is the amyloid, a much more frequent one the colloid, which in turn leads to the development of cystic goître. The contents of the enlarged follicles being continually changed into colloid material, there is an increase in size, often gained at the expense of the interstitial tissue, which atrophies. The adjacent follicles then coalesce and fill with gelatinous material, and thus, finally, large cysts may be formed. At the same time, the colloid material itself undergoes further changes, hæmorrhage often takes place from the cyst-walls into the cavity, and, finally, a brownish-red fluid containing mucin, albumin, blood, and its constituents, organic detritus, &c., is found to form the contents of the cyst. In rare cases, transparent fluid similar to that of hydrocele has been found. Occasionally, cholesterin, colloid material, phosphate of lime, &c., form the contents of cysts. Parenchymatous goître may, however, become cystic without passing through the colloid phase. This happens when the follicles undergo fatty degeneration, their contents being replaced by an albuminous fluid. The further progress is the same as that of the colloid variety.

Several cases of hydatid of the thyroid gland have been observed. In some cases, the development of the parasite led to great enlargement of the gland, and even pro-

duced serious dyspnœa. Two cases are known in which the cysts perforated the trachea, and immediate death ensued.

Most cystic goîtres are multilocular; a unilocular cyst being formed only by atrophy of the septa between the cysts. Often, however, even in such cases, a kind of fibroid stroma traversing the cyst remains. The capsule of the cyst is generally thick and smooth. Not rarely, more or less extensive calcification or ossification takes place within large, and even within small, cysts. Large goîtres, in consequence of their gravity, generally become pedunculated, the pedicle consisting of connective tissue, vessels, and nerves.

Finally, it must be stated that goîtrous thyroid glands show a decidedly greater tendency to become inflamed and to undergo malignant degeneration, than previously healthy glands.

Symptoms.—Apart from the external disfigurement of the neck, the main symptoms of goître are due to pressure exercised by the tumour upon neighbouring parts, especially upon vessels, nerves, muscles, air and food passages. All these symptoms are the more marked the less pedunculated the goître is; thus, enormous tumours hanging down in front of the chest often cause much less serious symptoms than much smaller tumours, which from their situation interfere with the function of important parts in their vicinity.

Amongst the first and most frequent symptoms, caused by small or non-pedunculated goîtres, is stasis in the veins of the tumour themselves, and in those of the neck and head. The former often appear as a large plexus on the surface and in the parenchyma of the gland, the superficial veins of the neck being at the same time much enlarged. With every effort these veins are further dilated. The veins of the head also sometimes suffer similarly, the face of the patient appearing turgid and red with every effort. The return of blood from the veins of the brain being sometimes impeded, the patient is apt to suffer from headache, giddiness, drowsiness, &c. On the other hand, tumefaction of the thyroid gland may lead not only to very considerable dislocation forward or backward of the carotids, but also to compression of these vessels, to diminution of the blood-supply to the brain, and to more or less marked phenomena of cerebral disturbance, such as convulsions, tetany, epileptoid attacks, the so-called 'goître-asthma,' and perhaps also to—sometimes fatal—spasm of the glottis from cerebral anæmia.

It is probably to such disturbances of the circulation in the brain, and not to pressure upon the pneumogastric nerves, that the transitory and varying paralysis of the adductors of the vocal cords, accompanied by aphonia, sometimes observed in young females affected with soft goîtres, and mostly occurring at times of general disturbances of the circulation (menstruation, pregnancy) must be ascribed.

Direct pressure upon the nerves of the neck is often met with in the harder forms of goître. The motor laryngeal branches of the vagi suffer almost exclusively. More sudden pressure may cause phenomena of irritation—i.e. spasm of the glottis (which, however, as shown above, may have an entirely different origin); more gradual pressure produces in the first place paralysis of the abductor fibres of the recurrent laryngeal (of both, if there be simultaneous pressure upon both recurrents, or pressure upon *one* pneumogastric nerve). Later on—i.e. when *all* the fibres of the nerve are disabled—complete paralysis of the corresponding vocal cord results. *See* Larynx, Neuroses of the.

Of muscles, the sterno-mastoid is most liable to be thinned and flattened out by pressure.

The most frequent and most important symptom caused by hard, non-pedunculated goîtres is dyspnœa, due to pressure upon the air-passages, notably upon the trachea. The larynx is not rarely considerably displaced, but hardly ever actually compressed. The trachea, on the other hand, is not only displaced, but the pressure causes at the same time softening of its cartilaginous rings and actual changes of its calibre. Thus, the wall of the windpipe may be either bulged inwards on one or both sides, or from the front; or a circular goître may constrict it on all sides, or it may be pressed against the vertebral column, or be quite bent over a hard goitrous nodule, &c. The dyspnœa is in proportion to the degree of narrowing. In slighter cases, tracheal stridor only occurs after efforts, in more severe cases it is constant. The dyspnœa is sometimes of the most serious kind, especially in cases of small substernal goîtres pressing the trachea against the vertebral column ('goître plongeant' of the French). Even if not immediately fatal, the deficient aëration of the lungs, coupled with ever-present increased respiratory efforts, generally causes, after a time, important organic changes of the thoracic organs, emphysema, pulmonary catarrh, dilatation of the right side of the

heart, &c. In cases of *tracheal* narrowing, the larynx does not rise and fall in respiration, however great the dyspnœa may be.

From a surgical point of view, attention is once more to be directed to the fact that the same goître may dislocate and compress the trachea, and simultaneously paralyse both abductors of the vocal cords. In such a case, a *double* stenosis of the air-passages results; an upper by diminution of the glottic aperture, a lower by compression of the trachea. It is rare that the gullet is compressed by goître. A small so-called 'aberrant' goître may be situated between the trachea and œsophagus and compress both canals, or the enlarged lateral lobes of the gland may not allow the gullet to shift its position. Dysphagia then occurs.

Sudden increase of a cyst means, usually, hæmorrhage from the lining walls into its interior; rapid increase of volume of a goître which had for a long time remained stationary, together with pain and swelling of the lymphatic glands of the neck, points to malignant degeneration.

Diagnosis.—The diagnosis of goître is for the most part easy. There are, however, cases in which it is very difficult, if not impossible, to distinguish goître from other tumours of the neck; and, again, it may be very difficult to differentiate between the individual forms of goître.

A general diagnosis will be arrived at by considering the history of the case, the characters of the tumour, and the associated signs: enlargement of vessels, paralysis of one or both vocal cords, bulging inwards of the trachea. In arriving at a differential diagnosis of goître from other tumours of the neck, it is a very important factor that goître rises during the act of swallowing, whilst other tumours do not, unless fixed by newly-formed connective tissue to the air-passages. Small substernal goîtres are sometimes apparent to sight and touch during the act of swallowing only.

Simple congestive swellings of the thyroid gland are generally transitory, and are due to menstruation, pregnancy, &c.; the neck appears somewhat full, and it is often difficult to make the gland out by palpation.

Parenchymatous goître is more resistant and more sharply limited. Generally, only parts of the gland are hypertrophied. These are smooth, somewhat elastic, only moderately enlarged. Fibroid goître is characterised by a number of single, movable, hard nodules, which project from the generally hypertrophied gland. If there be calcareous deposits in the nodules, their hardness is still more pronounced. Fibroid goîtres often assume enormous dimensions.

Cystic goître is usually globular or ovoid, sharply limited, and, when filled with thin fluid, shows distinct fluctuation. If, however, the wall be very thick or the contents more atheromatous, it may be very difficult to be sure whether there is fluctuation. Under such circumstances, an exploratory puncture must be made with a very fine trocar. Great care, however, should be exercised when this proceeding is determined upon, for dangerous hæmorrhage may be produced if the trocar unfortunately should injure a large vessel. The puncture should always be made under antiseptic precautions.

The goître of Graves's disease is characterised by vascularity, often by pulsation, and by the accompanying exophthalmos, rapid pulse and palpitations; often by blood-murmurs of the heart, in the carotids, and in the vessels of the thyroid gland.

Mixed forms (multilocular cysts, fibroid nodules, general parenchymatous enlargement,) are to be diagnosed by their unequal consistence, and, if necessary, by exploratory puncture.

The differential diagnosis of goître from other tumours of the neck, is rendered in some, fortunately rare, cases exceedingly difficult, by the fact that occasionally so-called 'accessory' or 'aberrant' portions of thyroid tissue at a considerable distance from the natural situation of the thyroid gland, undergo goîtrous changes. Even greater difficulties may present themselves when such aberrant masses of thyroid tissue are situated near the hyoid bone, behind the sterno-mastoid muscle, in front of the substernal portion of the trachea, between the trachea and œsophagus, &c. It will, therefore, be advisable to remember, in every case of tumour of the neck, the possibility of its being an 'aberrant' goître. The tumours most likely to be confounded with goître are congenital cysts (sometimes with sebaceous contents), blood-cysts, hydatid cysts in the gland itself or in other tissues of the neck, cold abscesses originating from broken-down lymphatic glands, fatty growths, adenomata, lymphomata and sarcomata of the lymphatic glands, and malignant tumours of the thyroid gland. The nature of cystic tumours, in the situation of the thyroid gland, will generally have to be made out by exploratory puncture. From malignant tumours of this neighbourhood, whether they start from the thyroid gland itself or from other structures, goître is distinguished by its usually slow growth,

painlessness and absence of tenderness on pressure, non-infiltrating character, and absence of general cachexia. It has been repeatedly mentioned that goître may undergo malignant change. This occurs sometimes, without any apparent cause, in cases in which a goître has been in existence for twenty years or more. All the symptoms just mentioned will then arise.

Treatment.—If an individual living in a goîtrous district becomes affected with goître, he ought to leave the neighbourhood as quickly as possible. Recent goîtres often disappear without further medication, if a change of residence into a non-goîtrous locality, especially to the seaside, can be effected. It has also been advised that the patients, and, in fact, all living in goîtrous districts, especially all those who have recently moved into them, should drink only *boiled* water.

The treatment varies considerably according to the nature of the goître.

Apart from change of residence, sojourn at the seaside, &c., iodine preparations are most serviceable in cases of soft, parenchymatous goître. They may be administered in the form of an iodide of potassium mixture (5–10 grains twice or three times daily) combined with the external use of an iodine ointment. The writer has often seen good results from the use, once or twice daily, of a combination of one part of the ung. iodi (B.P.) to 2–4 parts of the ung. potassii iodidi (B.P.). Broadly speaking, the effect of this treatment is the better and quicker, the younger the individual and the more recent the goître. In recent cases, even comparatively large goîtres often very rapidly and entirely disappear; in goîtres of longer standing, some diminution generally takes place, but not complete cure. The biniodide of mercury ointment, the applications of which in India are reported to be so marvellously successful, appears to have yielded less satisfactory results in the hands of European practitioners. Possibly the absence of the tropical sun, to the rays of which, in India, the neck of the patient is exposed during and after the application, may in some measure explain the difference. Dr. Morell Mackenzie recommends counter-irritation to the neck by means of applications of the liquor epispasticus (B.P.) in cases of soft goître. The iodine treatment above described will, however, be found to suffice in most cases.

Recently, Dr. Moritz Schmidt has advised, in cases of soft and of fibrous goître, the permanent application of cold to the patient's neck by means of Leiter's hollow lead-tubes, which are fastened round the patient's neck, and through which a current of cold water constantly circulates. In simple cases, these tubes are to be worn twice daily, each time for three hours; in cases in which dyspnœa is present, day and night. Dr. Woakes has lately recommended the internal use of hydrofluoric acid as an adjunct in the treatment of bronchocele. He administers ten minims (or more) of a half per cent. solution of the redistilled fluoric acid in an ounce of water, twice daily. The results appear to be somewhat uncertain. Several observers have added their testimony to its satisfactory effects; but in the hands of others—and the writer must class himself amongst them—the remedy has not yielded appreciable results, in spite of long-continued and repeated trials.

Should no good effect follow medicinal treatment in long-standing cases of soft goître, parenchymatous injections of iodine may be resorted to with a good prospect of effecting a cure; and this form of treatment will also be found useful in cases of fibrous goîtres, provided that the latter are not too old, too hard, and partly calcified.

The rules adopted by the writer are as follows:– (1) Select suitable cases only —i.e. cases in which the gland-substance is so thick that one may be fairly certain that the injection can be made into the parenchyma proper, and in which, on the other hand, the interstitial fibroid change has not progressed too far. (2) Inject every third day into the gland-substance proper a quantity, from 20 to 30 drops, of an alcoholic iodine solution (1 part of iodine in 12 parts of absolute alcohol), with a well-made and well-cleaned hypodermic screw-syringe. (3) Vary as much as possible the place of injection, and never inject into the same neighbourhood on two consecutive occasions. (4) Avoid wounding superficial veins and injecting air. A piece of tape may be tied round the neck below the tumour, so as to compress the superficial veins. (5) Neither insert the point of the needle *too timidly*, when the injection-fluid will very likely pass into the cellular tissue, suppuration resulting; nor *too violently*, when it may completely perforate the gland, and the injected fluid may be thrown into other important tissues. It is a good plan to let the patient swallow when the needle has been inserted, before the injection is proceeded with, the body of the syringe being held quite loosely in the operator's hand; if the point of the needle is in the gland-substance, the *foremost*

part of the syringe will rise with the rising gland; if it be in front of the gland, no movement will ensue; if it have perforated the gland, the *hindermost* part of the syringe will chiefly rise. (6) Never inject in such a direction that the point of the needle points directly towards the trachea or towards the great vessels and nerves of the neck. (7) Inject very slowly, and watch especially the effect of the injection of the first few drops. Select the place of injection carefully beforehand by palpation, and steady the tumour with the left hand whilst making the injection. Previous freezing of the surface with anæsthetic ether round the point selected for injection may be resorted to, but is not necessary.

Attention to the foregoing important precautions is very necessary to avoid unpleasant results. It must, however, be confessed that, even if they are punctiliously attended to, this form of treatment is not altogether devoid of risk, the principal dangers being—(1) injection of iodine or air into a vessel, causing embolism and sudden death; (2) lesion of the pneumogastric or of the recurrent laryngeal nerve, followed in some instances by spasm, in others by lasting paralysis of the vocal cord or cords; (3) suppuration and putrefaction of the goître. All these dangers are fortunately very rare, but, without any doubt, their occasional occurrence has been positively ascertained by clinical observation and by post-mortem examination, whilst, at the same time, they are—at least to some extent — uncontrollable. The writer, therefore, is of opinion that it is the duty of every surgeon not to represent the operation as a perfectly safe one, but to inform the patient or his friends, before beginning the treatment, of its risks.

Frequently, the patient complains, at or immediately after the injection, of radiating pains in the teeth, the occiput, the chest, &c. These symptoms are of no serious import, and usually pass away after a few moments. Shortly afterwards, slight tenderness and swelling over the point of the injection generally result, which are easily relieved by cold-water dressings. No definite statements can be made as to the number of the injections necessary to complete a cure, or the time required for treatment, both depending on the duration of the goître, its size, and character.

Instead of iodine solutions, other injection-fluids have been recommended at various times, notably pure alcohol, ergotine d'Yvon, liquor arsenicalis, and hyperosmic acid, but none of these have come into general use.

The treatment of parenchymatous, and especially of fibroid, goître by means of setons, which was at one time very much in vogue, has been almost entirely superseded by the iodine injections.

For the treatment of cysts three methods are employed: puncture with subsequent injection of an irritant fluid, incision, and excision. Simple aspiration has been given up almost entirely, as experience shows that the cyst, when simply emptied, almost always fills again very rapidly. Besides, simple aspiration is not quite safe.

In the writer's experience, the injection of perchloride of iron into the cyst yields more satisfactory results than injections o iodine, though it cannot lay claim to absolute safety. The best method of injection is that described by Dr. Morell Mackenzie in the following words:—'In carrying out this mode of treatment, I use a watery solution of perchloride of iron (25 per cent.), and I have for many years employed a syringe of somewhat peculiar construction. It consists of an ordinary glass barrel and piston, with a tapering metallic tube fixed at a slightly obtuse angle to its distal extremity. A circular ring, screwed on to the shank of the piston, regulates the distance to which the latter can descend. The object of this cylinder is to prevent the accidental passage of air into a cyst, and thus into a vein. . . . .

'The cyst is first punctured and emptied with a trocar at its most dependent part, a drachm or two (according to the size of the cyst) of the solution of perchloride of iron is then injected, the canula with its plug, and the iron solution being left in the cyst. After seventy-two hours the plug is removed, and the contents of the cyst withdrawn.

'If the fluid be then found to contain much blood, or if it be thin and serous in appearance, a second injection must be made. In other words, whilst hæmorrhage must be carefully prevented, a slight inflammation of the lining membrane of the cyst is essential. One injection is generally sufficient, but, if the first injection-fluid be too quickly removed, the process may have to be repeated three or four times at intervals of two or three days.

'When reaction has taken place, and the discharge is free from blood, the canula, with its plug, must still be kept in the cyst. Poultices of linseed meal should be kept constantly applied for three or four weeks,

sometimes longer. When suppuration is well set up, the plug may be removed, the canula, however, being allowed to remain until the secretions become limited in amount and thin in consistence.

'When the cyst is very large, it is best to try to reduce the quantity of the fluid before injecting. This can often be done by drawing off a small amount, say two or three drachms, at intervals of a day or two on several occasions. No attempt must, however, be made to empty the sac entirely, for if this is done, hæmorrhage takes place from the lining membrane of the cyst into its cavity, which soon becomes full again.

'The duration of the treatment is from three weeks to four months, according to the size of the cyst, the usual time being six to eight weeks.'

Incision of the sac, followed by suture of the free edges of the lining membrane to the edges of the skin-wound, has been recommended and executed with satisfactory results in a considerable number of cases; but there are several drawbacks to this treatment, amongst which may be enumerated the possibility of primary and secondary hæmorrhage, putrefaction within and around the sac, formation of fistulous communications with neighbouring parts, &c. The operation and the after-treatment should be carried out under strict antiseptic precautions, and all bleeding vessels be tied immediately, which is not always easy, especially if secondary hæmorrhage in the bottom of the sac occurs. In some cases, plugging of the sac with styptic tampons may be unavoidable.

In cases in which it is found that a large cyst, enclosed in a very thick fibrous wall, is only loosely connected with the surrounding parts, extirpation might be advantageously undertaken. This operation will best be performed, under antiseptic precautions, by shelling the sac out of its surroundings as much as possible by means of the finger or of blunt instruments, by ligaturing every vessel torn during this proceeding, and by dressing the resulting wound antiseptically.

Whilst, by means of one or the other of the above methods, it will be possible, in the larger number of cases, to prevent the occurrence of those grave symptoms which have been described in the paragraph on symptomatology, yet there are some goîtres which unfortunately do not appear to be amenable to any form of treatment; whilst others come under observation when these symptoms have already been fully developed, and when no relief can be expected from the adoption of any of the methods above recommended.

The grave symptoms referred to are mainly those of narrowing of the air-passages, which in turn, as has been shown, may be produced—(*a*) by direct compression of the trachea, (*b*) by spasm of the glottis, (*c*) by paralysis of the glottis-openers, (*d*) by the simultaneous existence of the conditions mentioned under (*a*) and (*c*). Now it is clear that, if we could be certain of opening the air-passages below the seat of the obstruction, this would be the simplest way of averting impending suffocation; but, in the first place, it is often impossible to say how far down the trachea is obstructed, and, secondly, the technical difficulties of tracheotomy in cases of large goîtres are often enormous, sometimes insuperable. Unless the goître extends too high up, the operation consists in opening the fascia propria, pulling down the isthmus of the gland by means of blunt instruments, opening the air-passages above the gland, and inserting one of Koenig's long flexible silver canulas, which are intended to force their way through the compressed part of the trachea, or, should no such canula be at hand, using a common elastic catheter for that purpose. In other cases, the surgeon may be compelled to ligature the isthmus on both sides, to split the ligatured part in the middle line, and then to open the trachea in the usual way. If, however, the goître be large, it will often be found that, in spite of the ligature *en masse*, severe hæmorrhage occurs when the isthmus is split, and the bleeding vessels will then have to be tied *seriatim*.

Much precious time is often thus lost, in cases in which the operation is performed in the greatest hurry to save the patient from impending suffocation. If the operation be performed at all, it is very important to keep the head very steady during the whole of the operation to prevent collapse and tilting of the trachea, and to keep it so afterwards by sandbags.

In order to reach the cause of the evil, and to ensure a radical cure in serious cases, removal of the goître may be necessary. The operation, which in former years was very fatal, is now, owing to advances in antiseptic surgery and improved methods, far less so than formerly; to the actual dangers of the operation must be added the possible occurrence of subsequent symptoms of myxœdema, due to the loss of the thyroid gland. It appears, however, that

myxœdema is not likely to occur if a small portion of the gland is left behind. The writer is, therefore, of opinion that extirpation of a goître may be undertaken when the condition of the patient appears to render this strictly necessary, provided that it is possible to leave behind a portion of the tissue of the gland.

With regard to the operation itself, there is at present considerable difference of opinion, but probably Kocher's method is the best. It is thus described by Sir W. MacCormac:—

'The manner in which the enlarged thyroid gland may be excised varies. It is essential to provide for an aseptic condition of the wound, and so avoid septic infiltration of the cellular tissue of the neck, which is very sudden in appearance, often without any very marked external change, while the result is almost always fatal. It is not less important to control hæmorrhage, as far as possible, and to avoid injury to the recurrent nerve. The superficial incision may be of two kinds, an angular and a Y-shaped. Where the enlargement is chiefly confined to one side, a median incision should first be made from the upper margin of the tumour to the notch of the sternum. In this way, only the transverse communicating branches of the veins will be divided, and from the upper extremity of this incision ample room can be obtained by making an oblique incision upwards and outwards, which should extend from the level of the cricoid cartilage to the anterior border of the sterno-mastoid muscle, or further, if necessary, in the direction of the mastoid process. The skin and platysma having been divided, the superficial veins will be cut through at right angles, and may at once be tied with double ligatures. Where the thyroid enlargement is bilateral, a similar oblique incision may be made on the opposite side. After the platysma and superficial fascia have been divided, the sterno-hyoid, sterno-thyroid, and omo-hyoid muscles appear spread over the tumour. As a rule, especially if the tumour be large, these must be divided, and, in some cases, part of the sterno-mastoid muscle as well; but this entails no serious after-consequences. The tumour will now be fully exposed, with enormously dilated veins covering, probably, its entire surface. These veins must be tied, one by one, with a double ligature before division.

'The greatest care must be taken at this stage, for the veins are not only huge in size, but their walls are very thin and easily torn or cut through by the ligature. The tumour may now be carefully separated by the finger, or handle of the scalpel, until the position of the superior thyroid artery at the superior lateral extremity of the thyroid body shall be reached. Here the superior thyroid artery will be found entering the tip of the thyroid tumour, and, either separately or together with its vein, must be carefully double-ligatured and divided between. The artery is generally much enlarged, and its walls are very thin.

'Search is now made for the inferior thyroid artery, which must be most carefully isolated previously to ligature. This may be applied as far as possible from its entrance into the tumour. . . . In this way the recurrent nerve will be well protected from injury. The inferior thyroid artery, after leaving the thyroid axis, passes transversely behind the outer border of the thyroid, and for some distance on its posterior surface before it penetrates the gland, after dividing into several branches. Close to the trachea, the trunk of the artery passes behind the recurrent nerve, which it partly encircles. The branches of the artery may be divided, after ligature, close to the surface of the gland, and bleeding will not occur owing to the preliminary ligature of the main trunk. . . . The tumour may now be turned towards the median line and lifted from the trachea. The further isolation should be conducted as carefully as possible until the isthmus is reached, which should be most carefully divided, each bleeding point being secured as it appears. When the enlargement is bilateral, the same operative procedure must be conducted on the opposite side. It is very important, if possible, to avoid performing tracheotomy, as it enormously increases the subsequent risks. . . . When tracheotomy is necessary, as it fortunately seldom is, the wound becomes speedily septic. It is better under these circumstances to treat it as an open wound with frequent irrigation, in the hope of preventing the fatal mediastinal infiltration which so often occurs.'

Finally, an operation must be mentioned, which, though only in its infancy, promises to be of excellent service in those cases in which operative interference is indicated on account of attacks of severe dyspnœa. This is *resection of the isthmus*, with or without the innermost part of the lateral lobes of the enlarged gland, an operation first advocated by Sir Duncan Gibb, and repeatedly performed with suc-

cess during the last few years by Mr. Sydney Jones. The operation is very simple:—The isthmus is carefully isolated. After having been exposed by a median incision, double ligatures are passed round its lateral parts, and the ligatured part is cut out, every bleeding point being secured as it appears. From the deep gutter thus created in front of the trachea, free drainage is secured during the process of healing. The results obtained by Mr. Jones with regard to relief from dyspnœa, dysphagia, laryngeal cough, &c., were very satisfactory. Perhaps the most remarkable result of this operation, however, is the fact that the lateral lobes left behind appear to shrink after the removal of the isthmus. FELIX SEMON.

THYROID GLAND, Injuries and Wounds of the.—Injuries and wounds of the thyroid gland are comparatively rare. When they do occur, other and more important organs (larynx, trachea, carotid artery, jugular vein, vagus, œsophagus) are, usually, simultaneously implicated. The isthmus is exposed to injury during operations performed in order to open the air-passages, and in homicidal attempts. The hæmorrhage which results is sometimes considerable. If the gland be injured by gunshot wounds, there is generally at first parenchymatous bleeding, not rarely violent secondary hæmorrhage. If larger vessels are injured, they should be ligatured if possible; if this, however, is impossible (especially in cases of secondary hæmorrhage), it may be necessary to tie the carotid or the subclavian. In parenchymatous hæmorrhage, digital compression ought to be tried; styptics must, if possible, be avoided, as extensive suppuration may be the result. There is no objection to sutures in incised wounds of the thyroid gland; under antiseptic precautions they often will heal by first intention. In addition to wounds, the thyroid gland is exposed to contusions, which may be followed by subcutaneous rupture of vessels. In all forms of injury, extensive infiltration, partly sanguinolent, partly œdematous, of parts of the gland or of the whole gland, and even of the neighbouring tissues, may ensue. This in turn may lead to active inflammation, manifested by any or all of the symptoms mentioned under that heading. *See* THYROID GLAND, Diseases of the. In the first stage of all injuries of the gland, energetic antiphlogistic treatment (ice, or Leiter's tubes to the neck, &c.) ought to be adopted; should active inflammation occur, this must be treated in the same manner as a common inflammation of the gland.

If, instead of a normal, an enlarged thyroid gland is injured, the chain of events is practically the same, only the symptoms, especially in the cystic forms, may be much more severe. Thus, in consequence of contusion, considerable hæmorrhage may take place into a cyst, leading to rapid and enormous enlargement of the latter, with compression of vessels and nerves, of the trachea, of the œsophagus, &c. Should the symptoms (dyspnœa, dysphagia) in cases of this kind be very severe, it may be necessary to puncture or even to incise and plug the cavity. In cases in which the symptoms are not so severe, the treatment recommended for wounds and contusions of the normal thyroid gland may be adopted. If possible, the bleeding vessels should be tied one by one. If a cyst has been opened by an injury, it will be best to treat it as if the cyst had been intentionally incised. In conclusion, it may once more be stated that all wounds of the thyroid gland in which the air passages have not been opened ought to be treated antiseptically, and that the artificial opening of the air-passages ought to be, if possible, avoided, as the wound becomes speedily septic under these circumstances. FELIX SEMON.

THYROID GLAND, Malignant Disease of the.—The malignant new-formations developing in the thyroid gland may be sarcomatous or cancerous. The causes of their origin are unknown, but it is certain that enlarged thyroid glands are much more liable to malignant degeneration than previously healthy glands. It is not very rare for a goître which has been in existence for twenty years or more, and the progress of which has been entirely arrested for a considerable number of years, suddenly, without any external injury or other evident cause, to undergo malignant change.

Sarcoma of the thyroid gland is comparatively rare. It may be very vascular, and may be either of the spindle, or of the round-celled variety. It develops very rapidly, early infiltrates the skin and the tissues of the neck, though it usually leaves the glands of the neck free, and encircles especially the great vessels. The air- and food-passages, however, are not frequently pressed upon to any serious degree. The reason of this is probably to be found in its very soft consistence, which may actually give rise to mistakes with regard to apparent fluctuation. The growth is very liable to sloughing and ulceration, with violent hæmor-

rhages and putrefaction. High fever and death from the local changes ensue, usually in the course of the first year after the growth has been noticed; in other cases metastatic tumours appear in the lungs and in the liver, and cause death.

Primary cancer of the thyroid gland is by no means so rare as had been supposed up to recent times; especially in goîtrous districts it comes comparatively often under observation. *Metastatic cancer* of the gland, on the other hand, does not appear to be frequent. The different forms of cancer which are met with in the thyroid gland are simple glandular carcinoma, epithelioma, and scirrhus. The glandular character, unless masked—as in the scirrhous forms—by proliferation of connective tissue, is very marked. The epithelial type may vary; some forms show more the character of cylinder-epithelial, others of pavement-epithelial, carcinoma.

Sometimes *secondary* tumours are observed, especially in the bones, which marvellously imitate the characters of the primary tumour, and which may attain a very considerable size. In other cases, metastasis occurs in the lungs and other internal organs. The progress of carcinoma of the thyroid gland is, usually, rather slow. There is generally, at first, gradual increase in size of the thyroid body, with occasional lancinating pains and enlargement of the anterior cervical lymphatic glands. After some time, the different organs of the neck are either compressed or infiltrated; the trachea may be displaced and narrowed, the œsophagus greatly compressed, the arteries and veins either compressed or entirely obliterated. The pneumogastric, recurrent laryngeal, cervical sympathetic nerves, and the brachial plexus may be involved.

The *symptoms* vary according to the organs interfered with: if the trachea be compressed, dyspnœa will ensue; if the œsophagus be narrowed, dysphagia will arise. Should the great veins be compressed or obliterated, œdematous swelling of the whole part will be produced; should the carotids be compressed, symptoms of cerebral anæmia may occur.

The nervous symptoms are equally variable. Compression of the sensory nerves of the part leads to very violent pains in the neck, which may also radiate into the occiput, the teeth, the area of the brachial plexus, &c. Compression and gradual destruction of the vagus may cause cardiac palpitation, and paralysis of the vocal cord or cords. *See* Larynx, Neuroses of the. Compression of a recurrent laryngeal nerve leads to paralysis of the corresponding vocal cord, the abductor fibres suffering first. Compression of the cervical sympathetic is the probable cause of the ptosis, sometimes seen on the side corresponding to the side on which the tumour is chiefly developed. Compression of the motor roots of the brachial plexus leads to more or less complete paralysis of the corresponding upper extremity.

Sometimes, there is a period of arrest even after the cervical glands have become infiltrated. This occurs, especially, when calcification takes place simultaneously in the thyroid body and in the affected glands. More frequently, however, the tumefaction steadily increases. Occasionally, adhesions are formed with the skin, which is gradually destroyed, and the tumour fungates. As a rule, however, general cachexia, dyspnœa, impossibility of swallowing, hæmorrhage, perforation of the malignant growth into the trachea or veins, secondary metastases, &c., bring about the fatal end before the tumour breaks down.

The *diagnosis* of carcinoma of the thyroid in its initial stages is not easy. It is always a suspicious circumstance when, in a person above the age of thirty-five, a goître which has remained stationary for several years begins to grow afresh and becomes painful. The further progress, the usually very great hardness of the tumour, the early dysphagia, the infiltration of the neighbouring lymphatic glands in cases of carcinoma, the almost fluctuating softness in sarcoma, finally confirm the diagnosis.

The only *treatment* which offers any prospect of relief is total extirpation of the diseased organ, and cases in which, at a comparatively early period, the existence of malignant disease has been diagnosed with certainty are, indeed, the only ones in which total extirpation would appear to be justifiable. In not a few cases, however, even of apparently *early* malignant degeneration, the surgeon who undertakes the operation will find the usual difficulties of extirpation increased tenfold, owing to the infiltrating character of the malignant growth. In not a few cases he may be compelled to leave the operation unfinished, owing to involvement of the large vessels or nerves in the tumour; or, on the other hand, to extirpate other parts (larynx, part of the œsophagus, or pharynx), together with the diseased thyroid body.

The *prognosis* is, under any circumstances, most serious. Still, there are several

cases on record in which the patients survived the operation for several months, and as lingering and terrible death is certain unless the diseased gland is removed, the operation, serious as it is, is fully justified.

FELIX SEMON.

THYROTOMY.—This term is used for the operation of laying open the thyroid cartilage in order to gain access to the larynx, less for purposes of facilitating respiration, than with a view to remove any mechanical conditions which may be interfering with laryngeal function or be otherwise dangerous to life. For the former purpose, the proper operation is either LARYNGOTOMY or TRACHEOTOMY.

The *indications* for thyrotomy are not numerous; among these, as the most common may be mentioned—certain cases of foreign bodies tightly wedged in the neighbourhood of the vocal cords, or in the laryngeal ventricles; strictures following ulcerative disease, burns, or other injuries; morbid sessile growths on (and chiefly below) the vocal cords, especially in the case of young and delicate children. Thyrotomy pure and simple is very unlikely to be performed on the living subject, for the cases, in which such an operation is called for, almost of necessity involve the subsequent use of a tracheotomy tube. Hence the question always arises, Shall the entire larynx, including two or three rings of the trachea, be laid open, or shall tracheotomy be performed independently, and, if so, shall this operation be done at the same time as, or a few days previously to, the thyrotomy? Unless there is something specially indicating the latter mode of procedure, the writer would recommend one operation. The chief object of a thyrotomy is to secure a free and full view of, as well as access to, the larynx. This will be best accomplished by opening the entire larynx and upper part of the trachea simultaneously; among other advantages, the alæ of the thyroid cartilage can be more widely separated than when a shorter incision is made.

THE OPERATION.—The patient being anæsthetised, a vertical incision, commencing a little above the pomum Adami, is made through the skin and fascia in the median line of the neck. This must be prolonged downwards to the isthmus of the thyroid gland; the muscles in front of the trachea and cricoid cartilage must be separated and drawn aside; any vessels which are met with must be treated in the same way; the trachea and cricoid cartilage are then incised (*see* TRACHEOTOMY) in the usual way, and a dilator inserted. This proceeding relieves all dyspnœa and any local blood-stasis which may have resulted. In some cases of papilloma, the growth will be visible through the wound at this stage. It may be well now to insert a tracheotomy tube, or a tampon; a piece of india-rubber tubing, of suitable calibre and length, lightly wedged in the trachea with a small bit of sponge to prevent blood trickling down, will be found both handy and efficient. The incision is next prolonged upwards through the crico-thyroid membrane, and thence into the thyroid cartilage, great care being taken to make it *exactly in the median line*. Suitable retractors being now inserted, the surgeon will see whether it is necessary to prolong the incision, and how far. An attempt should be made to preserve the integrity of the cords; if their anterior commissure must be cut, it is desirable to not quite sever the two thyroid alæ. In children and young subjects, in whom the cartilage is still elastic, retraction will accomplish much; but in old people, and in cases where it is necessary to get at the ventricles, or where the growth is very large and sessile, the incision may have to be carried not only through the alæ, but even into the thyro-hyoid membrane. To secure still more room, horizontal incisions may be made through the crico-thyroid and thyro-hyoid membranes, close to the upper and lower borders of the thyroid cartilage respectively. Bleeding vessels should be caught up and tied one by one: as a rule, the hæmorrhage is not great, and is easily arrested provided there is free respiration. In old people, the cartilages are so ossified that a fine saw is required to cut through them.

The subsequent steps of the operation will be determined by the nature of the lesion. If a foreign body, such as a piece of mutton bone, be found impacted in the ventricle or between the cords, or partially embedded in the wall of the larynx, it must be carefully enucleated and any necrosed tissue around it scraped away. If a new-growth be found, it must be eradicated in one way or another. In operating on a child for extensive papilloma recently, the writer found it very difficult to seize hold of the growth, owing to the reflex excitability which the approach of an instrument set up, notwithstanding deep narcosis. The use of cocaine in such cases will materially aid the surgeon, and permit him to ascertain accurately the exact mode

and place of attachment. Evulsion with forceps is to be deprecated, for fear of injuring the vocal cords. If the growth is pedunculated there will be no difficulty: it may be snipped off with a pair of fine curved scissors. In young subjects, the growths are usually sessile and often multiple; they must be caught up with forceps, one at a time, and snipped off with fine scissors curved on the flat, as near to the base as possible, which should then be touched with chromic acid. In cases of laryngeal cicatrix leading to stenosis, with or without implication of, or adhesions between, the cords, no exact line of practice can be laid down. In one case seen by the writer there appeared to be a kind of keloid in the cicatrix, and the aphonia which had existed appeared to have been due to displacement of one vocal cord from this same cause.

After the removal of the foreign body or the morbid growths, and the arrest of all hæmorrhage, the edges of the thyroid cartilage are to be most carefully adjusted, for on this depends much of the success of the operation. Two or three fine silver-wire sutures should be used; they need not penetrate through the entire thickness of the cartilage. The skin-wound should be sutured separately, and then covered with a pad of wet boracic lint. A tracheotomy tube must be left in the lower part of the wound.

After-treatment.—Too great care cannot be exercised to keep the patient absolutely quiet. All attempts at speaking must be disallowed until firm union has taken place; coughing is very prejudicial, for the increased volume of air forced into the larynx, even while a tube is worn, is very apt to burst the alæ of the thyroid cartilage apart. Let the patient be provided with a slate and pencil, and make known his wishes in writing. The croup bed, with a supply of steam (as described in the article on Tracheotomy), together with sedative inhalations, will be found of great advantage. Similar *complications* to those which follow tracheotomy may possibly occur, but they are much less frequent.

Prognosis.—The great danger of permanently interfering with vocalisation is a strong contra-indication to thyrotomy: hence the operation must never be undertaken when other measures are available. For morbid growths, the intra-laryngeal method of removal is now advocated by the best laryngologists, even in quite young children. Persistence and manual dexterity, they say, generally accomplish the desired end. The time, however, which is required for the repeated trials, not altogether free from danger, the risk of converting simple into malignant growths by the long-continued irritation, the chance of failure in the end, the necessity, in many of the cases, for wearing a tracheotomy tube to relieve the dyspnœa, with all the risks which this entails, in the writer's opinion, render the more radical operation preferable, in the case of children at any rate. The improved methods of operating, the local anæsthesia, the more certain attainment of healthy healing, the knowledge gained by past experience and failures, render the re-consideration of the intra- and the extra- laryngeal methods for growths desirable. *See* Larynx, Growths in the.

Robert William Parker.

TIBIAL ARTERIES. — The Posterior Tibial Artery runs from the lower border of the popliteus muscle, two and a half inches below the knee, downwards between the muscles of the calf and the deep group; it ends on the inner side of the ankle as low as a line drawn from the internal malleolus to the internal tuberosity of the os calcis.

The coverings, posteriorly, are the skin, superficial fascia, the muscles of the calf for the upper three-fifths of the leg; but at the lower part the cutaneous structures only. On the artery is the posterior tibial nerve, which is first on the inner side, then on the top, and finally on the outer side, at the ankle. Anteriorly, the vessel rests on the tibialis posticus, the flexor longus digitorum, the tibia, and a fatty envelope separating it from the ankle. Venæ comites accompany it. Around the artery and veins is a sheath continuous with the deep fascia of the leg.

Ligation of the artery is performed for wounds only. The wound is taken as the guide, and incisions made from it in the course of the artery. On the dead body the following are practised.

1. *To Tie the Artery in the Upper or Middle Third.*—Ligation of the lower third of the popliteal may be done by a similar operation to that of the upper third, except that the incision is made behind the internal tuberosity of the tibia, and the soleus is not cut through.

Place the patient on the back, semi-flex the knee, and abduct the limb. The operator stands upon the outside of whichever limb is being operated on. Make an incision one finger's breadth behind the internal border of the tibia, opposite the upper

or middle third of the tibia—say the middle. Cut through skin; superficial fascia, avoiding the internal saphenous vein; the deeper fascia; pull back the free exposed edge of the gastrocnemius; detach or cut through the soleus; pull the nerve backwards, open the sheath, disassociate the veins, and pass the needle from behind forwards—i.e. between the nerve and the vessels. The soleus muscle requires attention. On dividing the soleus parallel to its fibres, an aponeurotic sheath is reached, tense and pearly; when this is cut through, muscular fibres are again found, and require separating before the deep fascia of the leg, covering over the deep muscles and enclosing the tibial vessels, is reached. The muscular fibres upon the under or anterior surface of the soleus increase in number from above downwards.

2. *At the lower third of the leg* the artery is covered only by cutaneous structures, and is easily reached. Lay the foot on its outside; point the toes; make an incision over the lower third of the artery midway between the inner border of the tibia and the inner border of the tendo Achillis. Here the artery is found with a fatty surrounding, the nerve lying upon it or just to its outside.

3. *At the ankle* the artery is reached by a curved incision two inches long, and three-quarters of an inch behind the internal malleolus. In addition to the structures met with above are :—the internal annular ligament, a plexus of veins of the internal saphenous, and the venæ comites remarkably large. The posterior tibial nerve is one-eighth of an inch to the outer side.

The Anterior Tibial Artery runs, from the bifurcation of the popliteal at the lower border of the popliteus muscle, forwards over the top of the interosseous membrane between the tibia and fibula. From thence it runs down upon the interosseous membrane in a line from the head of the fibula to the middle of the ankle.

Coverings.—There is but little fat present in the superficial fascia, in which are branches of the internal and external saphenous veins and nerves; the deep fascia is tightly fixed above, below, and to the bony ridges laterally; the muscles are, from within outwards, the tibialis anticus, the extensor proprius pollicis, the extensor longus digitorum.

Lateral Relations.—In the *upper* fourth the artery has the tibialis anticus on the inner side, the extensor longus digitorum outside. In the *middle* two-fourths the artery has the tibialis anticus internally, and the extensor proprius pollicis externally. Just above the ankle the artery has the extensor proprius pollicis within, and the extensor longus digitorum without. The *anterior* relations are the coverings; the nerve is at first to the outer side, then it lies on the artery, and at the lower part is slightly outside again; the tendon of the extensor proprius pollicis crosses the artery just above the ankle. *Posteriorly*, the artery rests on the interosseous membrane above, and the tibia below for the lower fourth of its length.

Ligation of the vessel is performed for wounds of its trunk, and the operation is performed according as the wound is placed. The dead body operations are :—

1. *In the Upper Third.*—Semiflex the leg on the thigh, let the sole of the foot rest flat on the table, and adduct the knee slightly. In operating stand in front and make an incision in the guiding line for a distance of four inches. Cut through skin and superficial fascia. Then comes the question about the white line to be seen in the deep fascia; do not expect to see this white line, but cut through the deep fascia by an obliquely longitudinal cut or a crucial incision, and find out with the handle of the scalpel or director the separation between the muscles. Now flex the foot to relax the muscles, pull the lateral muscles outwards and inwards, open the sheath, avoid the nerve on the outer side, and pass the needle.

2. *In the Middle Third.*—Proceed in precisely the same way as above until the deep fascia is reached, when it is opened by a crucial cut. Then flex the foot on the leg, find the outer border of the tibialis anticus, and, entering the partition between it and the easily recognised tendon of the extensor digitorum, find the extensor proprius pollicis muscle. Pull the latter muscle outwards: carefully also pull the nerve to the outer side, open the sheath, and pass the needle.

3. *In the Lower Third* the artery is reached by an incision in the guiding line, which corresponds with the outer side of the tendon of the tibialis anticus. Do not carry the incision so low as seriously to cut the anterior annular ligament. The artery may be reached by pulling the exposed extensor proprius pollicis outwards or inwards. The nerve is pulled outwards as the needle is passed.

James Cantlie.

TIBIAL ARTERIES, Wounds of the.—Severe arterial hæmorrhage from the leg commonly occurs from the tibial or peroneal arteries, and may be considered as

arising under two distinct conditions—(1) hæmorrhage following amputation of the leg; (2) hæmorrhage following injury to the vessels in continuity.

(1) *Hæmorrhage following Amputations.*—Primary hæmorrhage occasionally gives rise to serious trouble in amputations of the leg, especially when performed through the upper third. This trouble does not, as a rule, occur in healthy subjects, but only in those whose arteries are brittle from atheromatous disease. The difficulty is a mechanical one, arising from the arteries lying between the bones rendering them difficult to seize with a forceps and to secure with a ligature. If the arteries are healthy, they may be drawn down somewhat, and by a little manipulation securely tied; but when diseased, they may be so brittle as to break away on each attempt to apply a ligature, making it impracticable to restrain hæmorrhage in this way, and necessitating an immediate amputation above the knee.

(2) *Hæmorrhage from Wounds of the Tibials in continuity.* — There are three chief varieties of wounds of the arteries of the leg—(1) incised wounds; (2) punctured wounds; (3) injury by a fractured bone.

Incised Wounds. — In these circumstances there can be no doubt that the bleeding vessels should be sought for and tied, for here, owing to the nature of the injury, the exact locality of the injured vessels is easily determined.

Punctured Wounds.—These, if occurring through the thick part of the calf or leg, give rise to serious questions in the matter of treatment.

Unpromising as the treatment may appear owing to the depth of the vessels, pressure and bandaging should be tried in the first instance, and cases are recorded in which this method has proved successful. For instance, in one case in which both tibials were wounded, it is mentioned that, 'on relaxing the tourniquet, and retracting the lips of the wound, the blood jetted up in several directions. It was found impossible to ligature the vessel without enlarging the wound to a considerable extent.' The limb was, therefore, bandaged from below upwards, and the patient recovered without further hæmorrhage. Again, another interesting case is recorded, in which a musket ball passed through the leg of a soldier three inches below the knee. Violent secondary hæmorrhage occurred, leaving the patient almost pulseless. The hæmorrhage was permanently arrested by pressure and bandaging, and the man recovered. Such cases are encouraging, and at least indicate that a trial of pressure should be made. Should pressure fail, or a traumatic aneurism form, operative procedures must be resorted to.

In the lower third of the leg, where the vessels are superficial, the wound should be enlarged, and the vessel sought for and tied; but, in the upper part of a thick limb there is some question whether the enlargement of the wound is the best form of treatment.

If the wound has been inflicted by a long narrow missile or instrument, the position of the bleeding vessel is often doubtful, for the puncture may run obliquely in any direction; and it is even possible that the divided artery may be on the side of the interosseous membrane opposite to the external wound. Dupuytren, when writing of a case of hæmorrhage from the calf caused by a pistol ball, thus describes the difficulty:—'Should a ligature be placed on the ends of the divided vessels? But, what were those vessels? Was it the anterior or posterior tibial, or the peroneal, or the popliteal? Was it several of them at the same time? Should they be attacked before or behind?'

Billroth, in his letters from the seat of war, draws a graphic picture of the difficulties, and in some cases the impossibility of tying a vessel in a granulating wound. He concludes by saying that in most of such cases, after much loss of blood has been incurred in the attempt, the main artery has, after all, to be tied. Beck and Stromeyer also congratulate themselves on the successful result of ligature of the main vessel.

The writer can verify the opinion of these eminent authorities by what occurred in a case where he was present, in which the posterior tibial was sought for and tied in a punctured wound in a large calf. The operation was a most severe and prolonged one, and, although with the greatest difficulty the vessel was ultimately found, the patient never recovered from the shock of the operation, dying on the third day.

Of course, it may occasionally happen that hæmorrhage from the calf occurs from punctured wounds, which, from the nature of the instrument inflicting them, cannot be very deep. In such cases, the wound may be enlarged and the vessel sought for, but if the calf be thick and muscular, and if there be violent hæmorrhage from a punctured wound of unknown depth; or should bleeding occur from the bottom of a deep granulating wound, and the hæmorrhage cannot be restrained by pressure, the main artery of the leg in the nearest accessible

position—namely, in Hunter's canal—may be ligatured with a fair prospect of success.

Wound from a Fractured Bone.—It has been taught, by an eminent authority on modern surgery, that a fracture of the leg with laceration of the tibials is a case for immediate amputation, but when such surgeons as Cæsar Hawkins, Dupuytren, and Syme have successfully treated cases of simple and compound fracture, with hæmorrhage from one of the tibials, by the Hunterian operation, it cannot be admitted that all such accidents should be treated by amputation. If the patient be young and healthy, and the soft parts but little damaged, it would certainly be right to attempt to save the limb by compression or ligature of the main vessel. In an old person or one in whom the skin and soft parts were much involved, doubtless the right plan of dealing with the accident would be by immediate amputation. HARRISON CRIPPS.

TINEA FAVOSA. *See* FAVUS.

TINEA TONSURANS (*Synon.* Ringworm; Herpes Tonsurans; Tinea Circinata).

Definition.—Tinea tonsurans is a contagious disease, chiefly attacking the scalp in children, and producing partially bald scurfy patches. It is caused by a vegetable parasite called trichophyton tonsurans.

Ringworm was first noticed by Willan under the name porrigo scutulata, and was subsequently very accurately described from a clinical point of view by several writers, especially Plumbe and Mahon, before the pathology of the disease was discovered by Gruby in 1844. His discovery that the disease was due to a minute vegetable parasite was quickly confirmed by others, and has ever since been generally, though not universally, accepted by the profession. The same parasite is now known to produce the less common forms or rather distributions of ringworm, called parasitic sycosis and parasitic onychia.

Symptoms.—Tinea tonsurans on the hairy parts presents features somewhat different in appearance from the same disease when seen on other parts of the body, and therefore a brief description of each is necessary. *On the scalp*, it is commonly met with in the form of roundish scurfy spots, which itch slightly; rarely, a few small vesicles are seen round the margin of the spots. Soon the hairs begin to be affected, they lose their lustre and break off near the scalp so as to produce partially bald patches, the short, stumpy, broken hairs being visible over the part affected; these stumps, which have frayed or bent and twisted ends, are of a rather darker colour than the healthy hairs, and give to the disease its characteristic feature. The general appearance of the patch, before it has undergone any treatment, has been not inaptly compared to the skin of a plucked fowl. On the scalp, ringworm spots sometimes occur singly; more commonly there are several, of sizes varying from a threepenny to a crown piece or larger: the larger patches often lose the rounded form. In some instances the patches spread rapidly at their margins, in others the process of development is comparatively slow. In addition to the breaking of the hair near its root, which is the *rule* in ringworm, there is also sometimes a shedding of the hair—that is, the hairs fall out with their roots attached; this is, unfortunately, quite exceptional. When it does occur thoroughly the disease gets well quickly, for with the complete shedding of the hair the fungus is also removed. Ringworm is quite unsymmetrical in its distribution, the spots being scattered about the head with marked irregularity; this is quite in accordance with the fact that it is strictly a local affection. Of course, in neglected cases the disease must tend to become symmetrical by the simple process of spreading over the scalp.

Tinea tonsurans of the hairy parts of the face is far from common; it now and then attacks the eyebrows of children who are suffering from ringworm of the scalp, but it is not very clear why this does not often occur; it is, in fact, rarely met with. Ringworm of the beard, constituting the parasitic sycosis of writers, is also a rather rare disease; when met with, it will generally be found that the sufferer is the father of children who have ringworm of the scalp. When the disease attacks the hairy parts of the face in adults, it causes more vesicular inflammation of the skin than is usually seen on the scalp in children, and for this reason is more likely to be mistaken for eczema. The diseased hairs sometimes fall off, but do not break off so readily as they do on the scalp, and therefore one valuable diagnostic mark is often absent. The patches spread at the margin and have a tendency to heal in the centre, and thus a ringed or serpiginous appearance is produced, which resembles a healing psoriasis. A similar condition is sometimes produced by ringworm about the pubes and scrotum, though in this country it is far from common in that region. All forms of ringworm of the hairy parts of the body are extremely

chronic and difficult to cure. When the disease spreads about the nates, as it sometimes does in those who follow sedentary occupations, such as shoemaking, and who sweat easily, it presents a well-defined raised margin, and hence was formerly called eczema marginatum, a term which ought now to be dropped out of use.

Tinea tonsurans of those parts of the body on which the hair is but little developed—such as the neck, trunk, and extremities—differs in appearance from the same disease on the scalp. On the body it is often called tinea circinata, but the name tinea tonsurans is to be preferred. It is usually seen in an early stage as a small round patch, or patches, of a slightly scaly appearance and of a pale red colour, with a sharply-defined and brighter red margin, which is a little more raised than the rest of the patch; as the patch increases in size, the central part assumes a comparatively healthy appearance, so that the spot becomes ring-like. Now and then a ring of small vesicles can be seen round the margin, and occasionally, though rarely, one ring forms within another, spreading apparently from a small central vesicle, and thus the so-called tinea tonsurans iris is formed. The general appearance of ringworm of the body is that of rounded patches of dry eczema with a well-defined margin and an unsymmetrical distribution; the itching is usually slight. Ringworm of the body is more difficult to diagnose than the same disease of the scalp, but is of much less importance, and is easily and quickly cured.

Morbid Anatomy of Tinea Tonsurans. For a general examination of the scalp, all that is required is a good-sized common magnifying glass; with this the diseased spots can be easily examined for affected hairs; two or three stumps should then be removed with a pair of forceps, and placed in a drop of liquor potassæ on a slide under thin glass, and examined with a good quarter-power under the microscope. The shaft of the hair will then be seen to be infiltrated and more or less split up with minute, round, bead-like bodies of about $\frac{1}{5000}$th of an inch in diameter; these are the *conidia*, or *spores* of the fungus, and, in addition, very fine filaments or threads may be seen permeating the shaft of the hair. These threads are the *mycelium*; they are not quite so easily distinguished as the conidia. Dr. Frederick Taylor's observations lead to the conclusion that the fungus does not usually extend downwards beyond the upper part of the bulb of the hair, and that, laterally, the spread of the fungus is limited to the inner root sheath, the *outer root sheath*, the *papillæ*, and the *walls of the follicles* being free from fungus. Clinical observation would tend to confirm Dr. F. Taylor's microscopical observation, for when *all* the hairs fall out over a patch of ringworm (as happens sometimes naturally and sometimes from artificial causes), leaving smooth, perfectly bald patches, the ringworm is entirely cured by the complete removal of the fungus; this could hardly be the case if the fungus extended much beyond the limits assigned to it.

Etiology.—It is now generally admitted that the *trichophyton tonsurans* is the essential cause of ringworm in all its forms, and that the disease is highly contagious, especially amongst children. Although it is very natural to suppose that the spores of ringworm might be transmitted through the air and thus reproduce the disease, yet there is very little evidence to show that this is really the case. The effect of implanting the fungus on a suitable soil is that it grows quickly, and in a few days may set up a little local inflammation, which is the first noticeable sign of the disease. If the soil is unfavourable, the growth of the plant is more slow, or it may even fail altogether, as is no doubt generally the case with adults. As a rule, when overlooked, it spreads rapidly in schools and amongst the younger members of a family, while those over the age of sixteen or seventeen often escape altogether. There is a prevailing opinion that young infants are not so susceptible of the disease as older children; they are, however, quite as susceptible, but they are generally washed all over once or even twice a day, and therefore the spores have not the same opportunity of taking root; moreover, in infants, in consequence of the poorly-developed hair, the disease is easily cured by very mild home remedies without medical help. Mothers, for example, among the poorer classes in London, are quite successful in curing ringworm on babies with common ink, though they fail entirely with the older children.

It is not very easy to explain why ringworm should be much more common in some parts of Europe than in others. It is perhaps most common in England, and least common in Northern Germany. The most reasonable explanation appears to the writer to be, that a humid climate with a mild winter is favourable to the development of the disease.

There is very little doubt that tinea tonsurans is not confined to human beings,

but is also occasionally met with in the domesticated animals. The writer has met with several instances where the disease has spread from cattle to the arms and hands of men tending them; in all these instances the ringworm has been of a severe type, and has given rise to much inflammation.

The differential diagnosis of tinea tonsurans on the scalp is usually very easy. The scurfy, partially bald spot with short, bent, stumpy hairs is very characteristic, and in doubtful cases the microscope will always determine the point. On the hairy parts of the face the diagnosis is much more difficult, and a microscopical examination of hair is always necessary.

Under some circumstances, the diagnosis of ringworm of the scalp is a little difficult: (1) when complicated with moist eczema or impetigo, so that the hair gets matted together; (2) when the hair is shed very rapidly, leaving smooth bald patches, very like those of alopecia areata. In both these cases we must chiefly depend on a careful examination of hairs under the microscope.

When the ringworm is confined to the non-hairy parts of the body, the diagnosis is sometimes difficult. The patches look like dry scurfy spots of eczema or psoriasis; but, unlike these diseases, ringworm often consists of a single round spot spreading from a centre, and, even when several spots exist, they are generally arranged in an unsymmetrical manner. Again, the ringworm spot has a very narrow, slightly raised margin, often of a brighter colour than the rest of the patch; this bright edge is very characteristic of the disease. If the disease has not been treated in any way, some of the scales may be scraped off and examined in liquor potassæ under the microscope.

Treatment of Ringworm.—The number of different remedies that have been discovered from time to time for the cure of ringworm of the scalp is almost endless. Those that have been recommended by experienced observers are all good remedies, but they are not all equally good, therefore the business of the medical man is to choose the most suitable one for the case before him, being guided in his choice by the circumstances of the case, such as the duration and extent of the disease, and the age of the patient. Whatever discoveries may hereafter be made with regard to new remedies, the difficulties will always remain, and well-established ringworm will always be a tedious disease to cure. The difficulty arises entirely from mechanical causes, which make it next to impossible to get the remedy in contact with the disease, this being, metaphorically speaking, under ground. The importance of this mechanical factor in the problem is well illustrated by the fact, that no disease is more quickly or easily cured than ringworm of the non-hairy parts of the body. In consequence of the very tedious nature of this disease on the scalp, patients often become the prey of quacks, in the vain hope that ignorant humbug will be successful where honest science has failed.

The *treatment* of ringworm in a very early stage is very simple, and consists in painting all the spots well over with the strong acetic acid. If the glacial acid is used it must be diluted with two parts of water, and applied carefully. If the ringworm is strictly confined to the surface, it may sometimes be cured in a few days by the strong acetic acid. Unfortunately, it very rarely is confined to the surface of the scalp, and therefore, after the acetic acid has been used for a week or fortnight, it should be discontinued, the sore places should be allowed to heal, and then a different plan of treatment should be adopted—namely, the inunction of an ointment. Of all the ointments that have been recommended, the writer has no hesitation in saying that the oleate of mercury is the most generally useful. It should be made by Dr. Shoemaker's double decomposition process. The pure oleate of mercury should be dissolved in melted benzoated lard, the temperature of which must not be much raised; the ointment may by used of different strengths according to circumstances, ranging from ten to twenty per cent. Before the treatment by ointment is begun, the hair should be cut quite short all over the head—as short indeed as is possible with a pair of scissors; this is better than shaving the head, because the spots of ringworm can be distinguished better when the head is not shaved. When the hair has been removed, the ointment should be *well rubbed* on all the spots night and morning. When an ointment is used, the head should not be washed oftener than once a week; if a lotion is used, it may be washed much oftener.

After the ointment has been used for some weeks, the process of epilation may be commenced, provided a fair number of hairs can be extracted entire: if nearly every stump breaks, it is useless to continue the process, but it should be tried again from time to time. The best plan of extracting is to take several hairs together,

and pull them steadily in the direction in which the hair grows; it is more easy to get them out this way than any other. If a mercurial ointment is inadmissible, the ointment of sulphurated potash of the P.B. may be used, but it must be often renewed, as it keeps badly. The oleate of copper ointment, of strength from one to three drachms to the ounce of lard, is a useful ointment and quite safe, but inferior to the oleate of mercury ointment; the bright colour is also a slight objection. Of lotions, that suggested by Dr. Cavafy is one of the best and least disagreeable, and is especially useful when the ringworm has spread rapidly over a large area, and is not of very long standing. By means of the lotion the area of disease may be greatly reduced, and then the obstinate spots may, if necessary, be dealt with by more vigorous treatment. The formula for the lotion is boracic acid ʒj., ether fʒj., rectified spirit to fʒvj. The lotion should be well applied with a small sponge two or three times a day. When using this lotion, there is no objection to the head being washed daily with warm soap and water, provided it is always carefully dried afterwards.

Disseminated ringworm is a very chronic form, in which the disease is scattered over the head in small groups or as single stumps, entirely concealed by the healthy hair round. This form of the disease requires especial care in its recognition and treatment, and can only be dealt with by Dr. Alder Smith's method, which he thus describes:—'In some inveterate cases —which have resisted the action of parasiticides—where all the patches have disappeared and the disease has passed into the *disseminated variety*, I believe the best chance of a cure is to subject the entire scalp to a very close examination with a lens, and to place, by aid of a *very* fine sable brush, a *minute* drop of croton oil wherever the isolated stumps or black spots can be seen. (A case where black dots are observed is one of the most difficult to cure.) If there are only a limited number, the oil can be pressed *into* the follicles by running the point of a very fine blunted gold pin into them by the side of the diseased stumps. The oil usually causes a pustule, and the loosened stump comes out with the discharge, or can afterwards be removed with a pair of forceps.'

The complications of ringworm are not many, but they are important—(1) Eczema and impetigo, (2) Kerion. Eczema and impetigo of the scalp are very troublesome additions to tinea tonsurans, for they not only prevent the necessary treatment of the latter disease being carried out properly, but they often favour the rapid growth of the trichophyton. The best plan, under these circumstances, is to dry up the eczema as fast as possible, and when that is cured, deal with the ringworm chiefly by mild remedies, such as boro-glyceride and the extraction of the hairs by the forceps.

Kerion is a peculiar circumscribed swelling of the scalp due to an acute inflammation of the follicles, which become dilated and discharge a sticky fluid. The portion of the scalp affected forms a soft raised swelling, which feels boggy to the touch, and strongly suggests a subcutaneous abscess; and under the erroneous impression that this is the case a kerion has often been cut into, to the disappointment of the surgeon, who finds nothing. The kerion should be simply treated with a little lead lotion on lint, and when the inflammation subsides, the hairs over the part affected fall out and the ringworm is cured.

The preventive treatment of ringworm is very simple, but often very important in large families of small children. The writer, in common with others, formerly recommended carbolised glycerine and carbolised oil as preventives, but a more extended experience has satisfied him that these remedies are needless and disagreeable, and do not always answer the purpose intended; indeed, *nothing sticky or greasy* should be used. The best plan is to keep the hair very short and the head well washed every day with warm water and soap; this keeps the skin and hair dry, and at the same time hardly allows time for the ringworm to get established.

Medical Certificates.—It cannot be denied that it is often very difficult to say whether a case of ringworm is absolutely cured, so as to justify a *formal certificate* to that effect. This is not surprising, when it is remembered that a single remaining stump containing spores may form a centre from which the ringworm may break out again, perhaps weeks or months after it was believed to be cured. Even the most skilful and careful medical men must sometimes make mistakes in this matter. But besides these excusable mistakes, there are many more made from want of experience and want of care. No formal certificate ought, of course, to be given that a case of ringworm is cured without a most careful examination. Very unfair pressure is often brought by parents to bear on medical men, in order to induce them to give certificates prematurely that children are perfectly

cured and may return to school without risk to others. There are of course different degrees of risk; the greatest occurs in elementary boarding schools, where the children are young and consequently very susceptible, and have bedrooms in common, and where there is more or less indoor romping. Under these circumstances, even when the treatment is carefully carried out, there must be risks of the disease spreading. In the case of day-schools where the children do not play or sleep together, the risk, under careful treatment, is much diminished. In the case of lads of fourteen or fifteen under good treatment, who have separate bedrooms and studies, and whose active association with other boys is chiefly in outdoor games, the risk is reduced to a minimum; but in all cases it is the duty of the medical man to withhold a *formal certificate*, however slight the risk may be, until the case is quite cured. ROBERT LIVEING.

TINEA VERSICOLOR. *See* PITYRIASIS VERSICOLOR.

TINNITUS. *See* EAR, INTERNAL, Diseases of the.

TOES, Amputation of the. *See* FOOT, Amputations in the.

TOES, Dislocations of the. *See* FOOT, Dislocations of Bones of the.

TONGUE, Diseases of the.—The diseases of the tongue will be treated in the following order:—

1. Congenital defects: atrophy; hypertrophy; tongue-tie. 2. Inflammatory diseases: acute glossitis; chronic superficial glossitis. 3. Leucoplakia (ichthyosis). 4. Eruptions or rashes: aphthæ; wandering rash. 5. Pigmentary affections. 6. Neuralgia: paralysis. 7. Tuberculous disease. 8. Syphilis. 9. Non-cancerous tumours in and beneath the tongue. 10. Cancer.

ATROPHY of the tongue may occur as a consequence of lesions affecting its motor nerve-supply. The wasting may be unilateral or symmetrical, and the degree to which it occurs will vary very much in correspondence with the cause. In ordinary hemiplegia the wasting may be scarcely noticeable; while, on the other hand, in disease of the medulla oblongata involving the hypoglossal nucleus, or after injury of the hypoglossal nerve, the atrophy may be considerable. The disease requires mention only here, as no question arises with respect to surgical treatment.

Congenital absence of the tongue is excessively rare, as are also defects of development to a less extent, in the form of fissures or clefts.

HYPERTROPHY OF THE TONGUE (*Macroglossia*, *Prolapsus Linguæ*) is a comparatively rare disease. Almost always beginning as a congenital affection, and in its early stages often overlooked, it may increase in severity until the tongue becomes too large to be retained within the mouth. It may even project beyond the level of the lips for two or three inches; the increased growth being helped by the irritation to which the organ becomes subject by its protrusion from the mouth, and its greater liability to be injured by the teeth. The hypertrophy may affect both sides symmetrically or one side more than the other. In the more severe cases, from exposure and constant irritation the mucous membrane becomes thickened and callous, and in some parts ulcerated from pressure on the teeth. The latter, after a time, become everted, from the constant pressure to which they are subject. In an extreme case, recorded by Chalk, the hypertrophied tongue had caused, by its weight, dislocation of the lower jaw.

The disease appears to be essentially a species of elephantiasis, consisting, as it does, of an overgrowth, especially of the lymphatic tissues of the organ. It is almost invariably an affection of infancy and early childhood. In Fairlie Clarke's table of forty-three cases, recorded by various observers, the disease was first noticed either at birth or before the age of six years in all but one; and in this instance the disease originated in mercurial glossitis and was therefore possibly not a true lymphangeioma.

Treatment.—The best and only reliable treatment is excision of as much of the enlarged organ as may be necessary for enabling it to be retained within the mouth. The operation may be performed by the knife, écraseur, or galvano-cautery. The écraseur is probably the best. A couple of broad curved needles should be made to perforate the tongue immediately in front of the proposed line of section, and the wire or whipcord should be looped over and behind them. The after-treatment will be the same as after excision of the tongue for cancer. *See* MACROGLOSSIA.

In mild cases benefit has accrued from direct pressure by strapping; and in a case of Teale's by pushing the tongue back within the mouth, and keeping it there by an elastic band under the chin. But such measures are of very uncertain benefit.

True hypertrophy must not be confounded with the protrusion of the tongue sometimes seen in idiots and in cases of sporadic cretinism.

Tongue-tie.—Undue shortness of the frænum linguæ is indeed a very rare affection. When it exists, the tongue cannot be protruded as far as the lower lip, and the act of sucking may be interfered with.

Treatment.—A snip of the frænum with blunt-pointed scissors is all the treatment required; the scissor-points being directed away from the under-surface of the tongue and towards the floor of the mouth, in order that the ranine artery may not by any chance be wounded. Before the application of the scissors the frænum should be stretched, either by the finger and thumb, or by means of the notched shield with which silver directors are usually provided.

Cases have been related in which the too free division of the frænum and subjacent structures has led to the sucking back of the anterior part of the tongue into the fauces, and consequent suffocation. It is difficult to believe that any such event could happen as the result of the operation, if properly performed. Similar accidents from undue length or absence of the frænum, or from malposition of the tongue, with defective development of the lower jaw and floor of the mouth, have been also recorded.

Acute Glossitis.—Acute inflammation of the tongue may arise from direct injury, especially when accompanied by the introduction of some irritating or septic matter, as from a wasp-sting, or from puncture by a foul knife, from exposure to cold, or from the undue administration of mercury. It may occur also as a sequela of the eruptive fevers.

At first œdematous and thickly coated, the tongue becomes swollen and acutely tender. Subsequently, it may become dry and red, or even black. Besides filling the mouth, or nearly so, on its own account, it is commonly pushed up to the palate by inflammatory swelling of the subjacent parts. Unable to protrude or even move it, the patient is also more or less incapable, in a severe case, of speaking or swallowing, while respiration may be also much impeded. If unrelieved, the tongue may protrude beyond the level of the teeth.

Acute glossitis may end by gradual resolution, or by more or less well-defined suppuration; the symptoms being at once relieved on the escape of pus from the tongue itself or from the tissues beneath. In very rare cases the inflammation may end in sloughing.

Treatment.—In a mild case of glossitis a saline purge should be given, followed by a draught containing gr. x.–xx. of chlorate of potash every four hours. The mouth should be frequently rinsed with a warm lotion of permanganate or chlorate of potash, or with a weak solution of carbolic acid (about 1 to 100).

If the swelling increase, the interior of the mouth should be carefully examined for any signs of localised suppuration; and a suspicion of fluctuation at any spot should be cleared np by puncture with a narrow abscess-knife, the operator having regard to the position of the main blood-vessels. If no sign of pus be detected, an incision of an inch or more in length should be made in the dorsum of the tongue, through the mucous membrane, on each side of the middle line; or the tongue may be punctured in several places. The incisions or punctures should be made sufficiently forward to be within reach in the event of undue bleeding. When the presence of pus is suspected, but where there is nothing to indicate its exact seat, a deep puncture may be made somewhere in the middle line either of the tongue or the anterior part of the floor of the mouth, and through this a probe-pointed steel director may be introduced for exploration. When the swelling is more especially in the sublingual tissues the exploratory puncture in the middle line may be made from without, between the chin and hyoid bone.

The more acute symptoms are usually relieved by the means just referred to; but the surgeon should be prepared, in a bad case, to perform laryngotomy or tracheotomy.

Chronic Superficial Glossitis.—*Glossy Tongue* (including so-called *dyspeptic ulcers*).—This is a very common disease; the morbid appearances presented by the tongue being due to repeated attacks of subacute inflammation, affecting the mucous membrane and submucous tissue. It is generally supposed to be, in most cases, of syphilitic origin; but we believe this to be a mistake, and that syphilis is accountable for only a minority of the cases observed. In the majority of cases of the disease, which is one chiefly of middle life, the predisposing causes are to be found in dyspeptic conditions, especially those which are the result of injudicious eating and drinking, while the disease is excited by local irritation—e.g. smoking, spirit-drinking, carious and foul teeth, and the like.

Sometimes, no sufficient cause can be discovered; but the disease will be always found to be aggravated by local irritation.

The appearances presented by the disease are very characteristic; the leading feature being an excessive smoothness or glossiness of the surface, as if all the papillary structures had been rubbed away. At one part the smooth surface of the tongue is red and as if raw; at another, not red but whitish, as if smeared with milk, or as if it had been touched with a solution of nitrate of silver. At another, there may be small, superficial, yellowish ulcers, or an irregular ulcerated surface, excessively tender to the touch or to anything hot or irritating. When at its worst the whole tongue may be swollen, and indented at the edges by the teeth. Here and there, remains of the proper papillary structure may be still visible.

The patient complains of much superficial pain and soreness, especially in the movements of the tongue in speaking or eating.

The microscopic characters of the disease are what might be anticipated from the naked-eye appearances. 'Expressed shortly, the changes consist in thinning of the epidermis, with destruction of the papillæ and other appendages; in thickening and increased vascularity of the corium, and infiltration of its superficial layers with nuclei or cells' (Butlin, *Med.-Chir. Trans.*, vol. lxi.).

Treatment.— Chronic superficial glossitis is a very intractable malady, and treatment should be directed rather to removing all the causes of an attack, and so preventing its recurrence, than to giving medicines with an expectation of quickly curing the disease by a specific. The mistaken notion that the disease is almost always syphilitic has had much to do, probably, with failures in treatment. The patient should live regularly and wholesomely, avoiding all spirituous liquors, and taking alcohol in any form with great moderation. He should not smoke; and if the teeth, natural or artificial, are not perfectly smooth and clean, he should have them made so as far as possible. Aperients (as blue pill and colocynth), with an occasional saline draught, should be taken, and any dyspeptic troubles should be treated.

The mouth should be rinsed occasionally with a weak carbolic lotion containing tincture of myrrh and eau-de-Cologne; and any ulcerated surface may be painted with a solution of sulphate of copper (gr. iij. to f℥j. of water), or chromic acid (grs. x. to f℥j. of water).

As a rule, the administration of iodide of potassium or of mercury will do no good, and may even do harm. But as it is not easy in all cases to distinguish simple superficial glossitis from that which has a syphilitic origin, these drugs should be tried in any doubtful or intractable case, not in ordinary routine fashion, but as supplementing the other measures referred to.

As in the case of all long-standing irritating affections of mucous membrane or of skin, chronic superficial glossitis may be followed by the formation of epithelial cancer. (See *Leucoplakia.*)

Leucoplakia. — *Ichthyosis*, *Psoriasis*, *Keratosis*, *Tylosis.*—This disease of the tongue, best termed *leucoplakia*, has attracted much attention during the last few years, chiefly on account of the fact, to which notice was first drawn by Hulke, that it not infrequently develops into epithelial cancer. The dorsum of the tongue is more or less covered, usually in a symmetrical fashion, by whitish patches, which, however, may vary much in size and appearance in different cases. In the milder cases, the tongue looks as if it had lost its papillæ, the surface being, in the part affected, more or less dry, smooth, and milky-white, with an appearance, often, of minute cross-hatching. In the least marked cases, indeed, there is little, if anything, to distinguish it from the effects produced by long-standing chronic superficial glossitis. The disease may, however, present appearances in different cases, varying from a mere 'milkiness' of the surface to a thick dead-white or yellowish covering, which, to the finger passed over it seems rough, or even prickly, and which reminds one, in its general aspect, of the sodden epidermis of the palm of a hand after long poulticing, or of a piece of rough and discoloured chamois leather. A similar appearance, but less marked, is very commonly seen on the mucous membrane of the cheek, especially just within the corners of the mouth, and extending from this part along the mucous membrane for a longer or shorter distance. The general appearance of the patches, especially in the milder cases, may vary in the same individual from time to time, probably in correspondence with the care taken to avoid all local irritation, as by smoking and drinking.

Differing so much as the cases do in their naked-eye characters, it is not astonishing that the microscopic appearances are found to differ also. Thus, in Hulke's

case of thick, tough, raised patches, to which alone (if ever) the term ichthyosis is applicable, the microscopic appearances were those of 'extreme hypertrophy of the filiform papillæ and their sheaths. These composite papillæ had an average diameter of 0·1 inch at their base and the average length of 0·25 of an inch. The epithelial sheaths of the secondary papillæ, instead of ending separately in brushes, cohered in solid masses' (Hulke, *Trans. Clin. Soc.*, vol. ii.). In cases of the mildest type, on the other hand, the microscopic appearances are indistinguishable from the effects of chronic superficial glossitis, and may be considered identical with them. In other cases, again, both mucous membrane and epithelium are thickened; but there is no extreme hypertrophic condition of the papillæ on the one hand, nor any marked effacement of them on the other (Goodhart; Sangster).

Unless the mouth be irritated, as, for example, by smoking and drinking, in which case the symptoms resemble those of chronic superficial glossitis, the disease may remain for many years without causing any notable trouble. Its importance, however, lies in the fact that after a variable number of years—it may be ten, twenty, or thirty, or more—the disease may develop into epithelioma, the latter being, in the author's experience, usually of the superficial, warty kind. In how many cases of leucoplakia epithelioma supervenes, it is impossible to say—possibly in only a small minority, as the milder forms of the disease are not rare, and, giving rise to no symptoms, would only come by accident under the notice of the surgeon.

With regard to the origin of the disease many causes have been assigned—syphilis, smoking, drinking, hot foods, and all other irritants. These, indeed, make the disease worse, and may act possibly as exciting causes; but it frequently exists without any such antecedents being discoverable. The disease is much more common in men than in women. *See* Psoriasis Buccalis.

Treatment.—The most important treatment lies in the careful avoidance of everything which may irritate the mouth or make it foul. The patient should abstain from smoking and from all spirits; he should live on plain wholesome food, with little or no wine or beer; care should be taken that no source of irritation is present in the shape of carious or sharp-edged teeth or in connection with artificial teeth. Mild cleansing or alkaline lotions may be used, if necessary. Any persistently ulcerated spot should be removed by the knife, or destroyed, if very limited in extent, by nitric acid. The pain produced by the latter is not so great as might be anticipated, and may be almost abolished by the previous application of a 20 per cent. solution of cocaine (T. Smith).

Aphthæ.—The tongue shares, with the inside of the lips and cheeks, a special liability, especially in infancy and early childhood, to the formation of small whitish spots or ulcers commonly termed *aphthæ*. Two varieties of this affection may be fairly differentiated one from the other—viz. (1) simple follicular or aphthous stomatitis, and (2) thrush.

(1) *Aphthous Stomatitis* is characterised by the appearance of small yellowish vesicles, which soon break and leave superficial ulcers, of about the size of a pin's head, with a whitish or yellowish surface and sharply cut edge with vivid red areola. Such ulcers, which may be single or multiple, are usually acutely tender, and cause much pain when, in the movements of the tongue in speaking or eating, they undergo friction against the teeth. Although most common in early life, follicular stomatitis in a mild form is not rare in adults, and, in both cases, is commonly associated with a furred tongue and other indications of a disordered condition of the digestive organs. In a severe case, the little ulcers may, some of them, become confluent and assume the form of so-called *ulcerative* stomatitis; but this condition is less common in the tongue than in the gums and inside of the cheeks, when it sometimes rather closely imitates the appearances seen in true cancrum oris. *See* Stomatitis.

Treatment.—Saline aperients, followed in an adult by the administration of dilute mineral acid in a bitter infusion, form the best constitutional treatment; and the mouth should be rinsed occasionally with a lotion of borax (gr. xx. ad $f\bar{z}j$. of water) or carbolic acid (1 to 100), and containing a little eau de Cologne.

Chlorate of potash is almost a specific for *ulcerative* stomatitis, and should be administered internally in gr. v.–x. doses, as well as applied locally in a saturated aqueous solution.

(2) *Thrush.*—The characteristic small whitish or yellowish spots in 'thrush' are much more numerous than in simple follicular stomatitis; the tongue and other parts affected looking as if thickly dotted over with tiny particles of curd, which in severe examples of the disease may coalesce and form patches of false membrane. The

white spots are firmly adherent to the mucous membrane, and when peeled off leave the surface red and sometimes abraded. There is some heat as well as tenderness in the parts affected.

Thrush is especially a disease of infancy (although it is met with sometimes in the course of wasting diseases of adults), and is almost invariably associated with disordered nutrition; the little patients being more or less emaciated, and frequently suffering from diarrhœa, with green and fetid motions. Although thrush depends essentially on disordered nutrition arising most commonly from improper or insufficient food, there is no doubt of its being immediately associated with the development in the diseased epithelium of a microscopic vegetable fungus (*oïdium albicans*), which, if it does not constitute the essential cause of the local disease, may be considered to aggravate its symptoms.

Treatment.— The predisposing causes of 'thrush'—insufficient or improper food, sour milk, want of cleanliness in regard to feeding-bottles and other vessels—and the diarrhœa which ensues as a consequence, all suggest the general treatment which is in most cases requisite. Local treatment is also important. Dr. West advises that the mouth should be carefully wiped out with a piece of soft rag dipped in a little warm water after every time food has been given, and that, afterwards, a lotion of borax (gr. xx.-ʒss. to fʒj. of water) should be applied. If the borax seem insufficient, a mild carbolic acid lotion (1 to 100 of water), or one containing permanganate or chlorate of potash, may be employed. In adults, aphthous ulceration of the tongue, whether associated or not with the presence of *oïdium albicans*, is a painful affection, and is usually met with in the last stages of wasting diseases, as cancer and tubercle. Various remedies are usually required for its treatment; sometimes one appearing to answer best and sometimes another. In addition to the means above-mentioned a lotion of sulphite of soda (ʒj. to fʒj. of water) may be tried; or a lotion containing glycerinum boracis and water in various proportions. In some cases, when the tongue is very dry, great comfort is given by painting it with a camel's-hair brush dipped in pure glycerine (Cotter).

Wandering Rash.— This very rare disease, the first account of which, in this country, we owe to Mr. Arthur Barker (*Pathological Soc. Trans.*, vol. xxxi.) is characterised by the appearance of small circlets or crescentic bands of light-coloured 'rash.' These extend rapidly, and wander from place to place centrifugally over the dorsum and occasionally the borders and under-surface of the tongue; what was only a round whitish or yellowish spot in the morning may have become a large ring in the afternoon, and have totally disappeared a few hours later. Itching and salivation sometimes accompany it, and form its leading symptoms. In some cases it causes scarcely any symptoms, and the patient may be unaware of its existence. Its resemblance in appearance to ringworm is very striking, but the disease appears, from Barker's observations, to be not parasitic.

With respect to prognosis, there appears to be nothing to fear beyond the discomfort arising from the itching; no serious sequelæ having been noticed, even in cases in which the disease has lasted for some years.

Treatment, whether local or constitutional, has little or no effect on its progress.

Pigmented Tongue. — Of pigmented tongues there are several varieties. In one of the most marked (*black tongue*) the disease appears in the form of an oval or circular patch placed in the middle line of the dorsum, and is caused by the deposit of some black material in the thick epithelial investment of the papillæ, especially the filiform, which may be at the same time abnormally elongated. The black patch may vary in size at different times; in some instances almost the whole of the dorsum being affected. The cause of the disease is unknown. It gives rise to no symptoms as a rule, and requires no treatment.

In another variety of black tongue the disease takes the form of small black dots and patches, most marked on the edges of the tongue and seated apparently rather in the corium than in the epithelial cells. Similar dots and patches may be seen on the tongue in Addison's disease. The possibility of black tongue being produced by an intentional or accidental application of colouring matter by the patient, should be borne in mind.

Xanthclasma of the tongue is very rare; but a well-marked case has been not long since reported by Dr. Wickham Legg, in which the disease appeared not only in some of the more usual situations, but also in the form of yellowish, slightly raised patches on the sides of the tongue.

Neuralgia. — Neuralgia, affecting the tongue chiefly or exclusively, is a rare disease. It does, however, occasionally

occur, and, like cases of the same affection in other parts, may be exceedingly obstinate under all treatment. Beyond the measures which would be tried as a matter of course, such as large doses of quinine and careful attention to anything wrong in the general health, may be recommended the local application of menthol (Butlin) or of solution of cocaine, four to twenty per cent., or the local injection of morphia, beginning with a small dose only (gr. $\frac{1}{8}$ or $\frac{1}{6}$), and cautiously increasing it if necessary.

If the disease does not yield to these measures, the operation of stretching or division of the gustatory nerve may be performed. *See* Gustatory Nerve.

Tubercle : Lupus. — Tuberculous or scrofulous ulceration of the tongue is a rare disease, although possibly less rare than is generally supposed, on account of its not being sufficiently distinguished from the much more common syphilitic and cancerous affections of the organ. It usually presents itself in the form of an œdematous, glazed, inflamed ulcer with yellowish surface, very tender, but not fissured or warty or sloughing, or suggesting the idea of much new-growth. In almost all cases the patient is the subject of other scrofulous manifestations. There is either scrofulous or lupoid ulceration in the throat, or suppuration of a like kind in the cervical glands, or the patient is the subject of advanced phthisis—laryngeal or pulmonary. The tip and edges of the tongue are favourite sites for the tuberculous ulcer, but it may attack any part of the organ.

Diagnosis.—The only form of syphilitic ulcer, with which the tuberculous is likely to be confounded, is the tertiary or gummatous; and from this the diagnosis is not very difficult, if the history and accompanying conditions are carefully considered. The tuberculous ulcer is usually much cleaner than the syphilitic; the glazed and raw surface being more like that of an ordinary inflamed but sluggish and irregular wound, produced by some injury. The acute tenderness of the ulcer is also characteristic, especially when it involves the tip or edges, and is more likely to lead to the disease being confounded with a cancerous than a syphilitic ulcer. The absence of other evidences of syphilis is also important, and last, but not least, as a diagnostic indication, is the failure of iodide of potassium to give any marked relief. Frequently, the early age of the patient affords help in diagnosis.

The diagnosis of tuberculous ulceration from cancer is not always easy; the pain and distress in both being often very great, and the failure of all remedies to give relief being about equally marked. But in the tuberculous tongue there is less evidence of infiltration by new-growth; its general aspect being rather that of an irregular inflamed *ulcer* than of *tumour*. There is comparatively little adhesion of the tongue to neighbouring parts, even when the disease has long existed; and although remedies give but little relief, the progress to evil in the scrofulous ulcer is much less rapid.

A valuable means of diagnosis may also be afforded by gently scraping the surface of the ulcer, and examining the specimen mixed with a drop of water under the microscope.

Treatment.—The general treatment of scrofulous disease in the tongue is identical with that which would be appropriate to tubercle in the larynx or lung. For local treatment see *Palliative treatment of Cancer of Tongue*. In a case in which the disease is well-defined and comparatively limited, erasion by means of a Volkmann's spoon, followed by the application of nitrate of silver or of iodoform, may be tried. Excision is sometimes, though rarely, advisable.

Lupus vulgaris affecting the tongue may be considered to be included in what has been said regarding tuberculous disease. So far as any diagnosis between the one form of strumous disease and the other is possible, it will be found in the presence or absence, at the same time, of lupus of the face or nasal passages or pharynx. The treatment is the same for both.

Syphilis.—Syphilis affecting the tongue may take the form of—(*a*) chancre; (*b*) condylomata or mucous patches, or superficial irregular ulceration; (*c*) tertiary syphilitic deposits (gummata) or ulceration.

(*a*) Chancre is exceedingly rare, and needs only to be mentioned.

(*b*) Condylomata and mucous patches are almost always accompanied by similar manifestations of syphilis in other parts of the mouth and elsewhere, as on the penis and about the anus. They require no special description. When not in the form of condylomata, secondary syphilitic ulceration of the tongue takes the form, usually, of an irregular whitish or yellowish superficially ulcerated or abraded surface, especially along the edges. The tonsils are usually ulcerated at the same time, and the corners of the mouth may be fissured.

With regard to treatment, it will suffice here to say that mercury should be cautiously administered either by the mouth

or by inunction. *See* Inunction; Syphilis. Much benefit will be produced also by local treatment, as by painting with a solution of chromic acid (gr. x. ad f℥j. of water) or a solution of the cyanide of mercury (gr. xv. to f℥j. of water).

Ulceration of the tongue produced by the injudicious administration of mercury may be confounded with syphilis, and is often associated with it. The foul breath, the spongy gums, the œdematous and indented tongue, with the history, will guide to a correct diagnosis; which will be confirmed by the good effects of a saline purge, with cleansing lotions, as of chlorate of potash (gr. x. ad f℥j. of water) or carbolic acid (1 part to 100 of water with a little eau de Cologne).

(*c*) Tertiary syphilis of the tongue usually takes the form of gummata, which may or may not be ulcerated or sloughing. When the surface is unbroken, the disease, in the form of tough nodules or tubercles, may be situate in any part of the tongue, but rather on the dorsum than the edges. These are very irregular both as to number and individual size, and are not commonly either very tender or painful. Sometimes, they are crowded together so as to give to the tongue a very irregular surface, with apparently deep furrows or fissures; but the latter are not necessarily ulcerated or even abraded. When no ulceration or abrasion is present, such a tongue may give the patient but little trouble; while at another time there may be considerable distress in consequence of some glossitis and superficial ulceration, with temporary enlargement of the tubercles and apparent deepening of the fissures. In another case, the gumma may slough or ulcerate, leaving a deep cavity with irregular walls and up-standing edges; the general appearance sometimes closely simulating malignant disease.

As a rule, the diagnosis between syphilis and epithelial cancer is not difficult. The best diagnostic signs of syphilis are—(*a*) the comparative absence of pain and of tenderness, especially on making firm pressure; (*b*) the tongue is not fixed by adhesions even in severe cases of syphilis; (*c*) tertiary syphilitic ulcers are usually in some part of the dorsum rather than on the edge, and are not usually single; the remainder of the tongue is also commonly more or less affected; (*d*) there is no marked salivation from reflex irritation; (*e*) a syphilitic tongue, likely to be confounded with cancer, should be *rapidly* and greatly benefited by the internal administration of iodide of potassium; (*f*) the presence or absence of any history of primary syphilis should be also duly (but not unduly) weighed in making a diagnosis.

Treatment.—The treatment of tertiary syphilis of the tongue lies in the internal administration of iodide of potassium, either by itself or combined with small doses of mercury. Calomel vapour-baths, if carefully given, are also useful; or mercury may be given by inunction. *See* Inunction; Syphilis. The local treatment is the same as that advised for secondary syphilitic ulceration. It frequently happens that a long-standing disease of the tongue, which is undoubtedly in its origin and even in appearance syphilitic, is really not syphilitic, and requires quite different treatment from that just mentioned. Tongues scarred and tuberculated by old syphilitic ulceration may never regain their normal texture, although the syphilitic element fades away by lapse of time, or is cured by treatment. Such tongues are easily irritated by injudicious eating and drinking into an extremely sore and troublesome condition, and the patient gets little or no benefit, and may even get harm, from the quantities of iodide of potassium or of mercury which are being constantly taken. Such cases require treatment identical with that mentioned under the head of *Chronic Superficial Glossitis.*

Non-malignant Tumours. — Tumours of the tongue (using the term in its usual sense) are almost always cancerous. But others are occasionally met with. Simple wart or papilloma, mucous, hydatid, and other cysts, fatty and fibrous tumours, keloid, enchondroma, and sarcoma have been all recorded. All are rare, and space permits here only mention of them.

Nævus.—Nævus of the tongue is a somewhat rare affection. It presents no difficulty in diagnosis; the general appearance and characters resembling very much those which are so familiar in the case of the skin. The purplish smooth swelling, dotted here and there with red, which disappears on pressure and quickly reappears when the pressure is removed, without hardness or pain or tenderness, can scarcely be mistaken for any other disease. As a rule, nævi give no trouble, and but rarely require any treatment; and unless they cause inconvenience by their size or bleed from injury by the teeth, they should not be interfered with, especially as they share, with similar growths in the skin, a tendency to wither as age advances.

Occasionally, it is necessary to remove a nævus, and, in this case, the knife or scissors may be employed if the tumour is small; the operator, after securing the tongue by a thread passed through its tip, cutting into the sound tissue around the nævus, and not, if it can be avoided, into the nævus itself. In cases of more extensive disease, removal by the écraseur is preferable, the operation being planned after much the same fashion as for other tumours. In some cases, the application of the actual cautery or galvano-cautery to the nævus, as in the case of some nævi of the skin and subcutaneous tissue, is advisable, in lieu of the more complete removal by the knife. Paquelin's cautery is convenient for the purpose; one of the more pointed instruments, at a dull-red heat, being introduced, here and there, for a few moments into the substance of the growth.

Cirsoid aneurism of the tongue is very rare. In a case recorded by Sir Joseph Fayrer, which bore a superficial resemblance to a large ranula, and which was subject on occasion to severe hæmorrhages, much benefit was obtained from the injection of a strong solution of tannic acid.

Warty Tongue. — *Sago Tongue.* — A rare but well-marked disease of the tongue is sometimes seen in which the organ is at one part warty or papillated; the individual projections, however, not looking like enlarged lingual papillæ, but having a gelatinous semi-transparent aspect, not unlike boiled sago-grains. The part of the tongue affected is generally thickened.

Unless, by chance, the tongue is bitten from its projecting between the teeth, no symptoms are perceptible by the patient, and the disease may be discovered only by accident.

The disease is probably, in its origin, nævoid; the peculiar appearances observable being caused by a degeneration of the nævus structure. No treatment is required.

Cancer.—Cancer of the tongue, which may be said to be always epitheliomatous, may begin either as a small lump or warty tubercle, or as a small ulcer or fissure, with hard edges, and tender on pressure. Unfortunately, it is only in a small minority of cases that the surgeon is called upon to diagnose the disease at a very early stage. Much more frequently, the disease is more advanced when the patient seeks relief, and is then in the form either of a warty or ulcerated mass, which projects slightly from the surface but is connected with it by a broad base, which dips down more or less deeply into the substance of the tongue; or, on the other hand, in the form of a well-defined ulcer, somewhat excavated, with hard edges, which seem infiltrated in the substance of the tongue. As the disease extends, it gradually encroaches on neighbouring parts, infiltrating not only the muscular substance of the tongue, but the mucous membrane and other structures which form the floor of the mouth, and even the gum and the lower law.

The mobility of the tongue is by degrees more and more interfered with, as it becomes bound down by the encroachments of the disease on neighbouring structures. Speech, mastication, and deglutition are all painful and difficult. Apart from any movement, moreover, the tongue is the seat of acute neuralgic pain, which radiates to other parts, especially to the ear and side of the head; while, by reflex excitation, the salivary and mucous glands are stimulated to secrete profusely. The lymphatic glands beneath the jaw are usually more or less enlarged and tender, when the disease in the mouth has begun to give rise to much pain and irritation; but in the early stages of the affection this symptom may not be present.

Diagnosis. — The diseases with which cancer of the tongue is most likely to be confounded are—(1) tertiary syphilis, (2) tuberculous ulcer, (3) simple ulcer from irritation.

(1) From syphilis, cancer is best distinguished, at an early stage, by its hard edge and excessive tenderness, the patient wincing on even moderate pressure; while, a little later, the tendency to adhesion of the tongue to neighbouring parts, the increasing pain of a neuralgic character, radiating to the jaw and side of the head, the extreme tenderness, with largely increased secretion of saliva, leave but little doubt as to diagnosis, even apart from the extent, very various in different cases, to which the infiltration by new-growth and the destruction by ulceration have extended. If the neighbouring lymph-glands are enlarged, there may be the less doubt regarding the nature of the disease; but the absence of such enlargement counts for very little at an early stage, and should be disregarded in making a diagnosis.

Absence of history of primary or secondary syphilis is, of course, to be counted as a diagnostic sign in favour of the malignant nature of the disease; but its presence should be reckoned as of slight value only in a case which, on other grounds, seems cancerous. A patient who has suffered

from syphilis is not *less* likely to have cancer than another.

(2) From the tuberculous ulcer, cancer may be best distinguished by the symptoms mentioned in connection with the former.

(3) A chronic simple ulcer, produced by irritation from a sharp tooth or artificial tooth-plate, or the like, may occasionally give rise to a suspicion of the presence of cancer. The absence of a hard edge or base will usually distinguish it; and, with proper care, the presence of anything in the mouth likely to cause such an ulcer will not be overlooked. Care should be taken, however, not to treat too lightly any apparently simple ulcer; inasmuch as a cancerous sore may, at its beginning, attract a patient's notice in consequence of friction, which to a healthy tongue would have been imperceptible.

In cases of doubtful diagnosis between cancerous and other ulcerations of the tongue, valuable help is sometimes got by gently scraping the surface of the ulcer, and examining what is obtained under the microscope. In the case of a non-cancerous ulcer, only elements will be found such as might be afforded by any simple ulcerating surface, 'pus and blood-corpuscles, débris of food, schizomycetes, and even epithelium. But the epithelium bears no resemblance to that derived from the cancerous ulcers. It is well formed, of more equal size, and regular shape—not granular, and the nuclei are exceedingly small in comparison with the large size of the cells.' On the other hand, 'the scrapings of cancerous ulcers contain always numerous epithelial cells, in addition to pus- and blood-corpuscles, and débris of food, and schizomycetes. But the epithelium differs widely from the healthy epithelium of the tongue. The cells vary much in shape and size, and often present singularly distorted forms; their nuclei are always much larger than those of normal cells, and sometimes there are several nuclei or even nucleated cells within the larger cells; while a greater or less quantity of granular material always occupies the interior of the cells. Not infrequently cell-nests or fragments of cell-nests may be observed' (Butlin).

The *microscopic appearances* of epithelioma of the tongue resemble very closely those seen in the like disease of other parts of the body. 'Processes of epithelium dip down from the epidermis into the subjacent textures. These processes, however numerous they are or large they may become, do not usually combine to form a continuous mass or solid block of epithelial cells, but become connected at short intervals by horizontal bars of cells, so as to enclose what look like areas of irregular form. These areas are really spaces, communicating freely between the anastomosing bands of epithelium, filled with the altered tissues of the tongue, infiltrated with leucocytes.' 'Cell-nests may be discovered without difficulty in almost every epithelioma of the tongue. Often large and well-formed, they rarely present the horny and finely-stratified appearance of similar structures seen in squamous carcinoma of the skin, but rather resemble the cell-nests which may be observed in the epidermis of the normal tongue' (Butlin).

The *duration of life* in cases of epithelioma of the tongue is very different in different instances. It may be measured sometimes by a few months, in other examples by many years. In a very few we may hope that the disease has been, by surgical operation, completely eradicated. When fatal, the disease almost always destroys by long continuance of pain, discharge, and interference with the swallowing of food; the end being hastened in many cases by hæmorrhage from vessels, of larger or smaller size, laid open in the course of the extending ulceration. Occasionally, a low form of septicæmic pneumonia, with partial destruction of lung-tissue, occurs—possibly the result of direct irritation of the lung by inhalation of matter from the foul discharging surface of the cancerous ulcer.

Treatment.—The question of treatment of cancer of the tongue resolves itself, in the first place, into whether the given case is one fit for surgical operation; and the reply may be briefly summed up by saying that the disease should be removed in all cases, in which complete removal is possible without undue danger to the life of the patient. There are many cases, too, in which it is advisable to remove the disease, even when it is not possible to be sure that the removal is *complete*. This point will be referred to hereafter. When possible, diseased lymph-glands should also, of course, be removed.

Palliative Treatment.—Many cases of cancer of the tongue are seen too late in the progress of the disease to permit the performance of any operation for its removal; and in some instances recurrence will occur *in situ*. The palliative treatment of all such cases is, therefore, most important, and although little can be done to delay the progress of the disease, very

much can be done often in the way of alleviating pain and distress.

(1) Very frequently it will be found, on examination, that the ragged and ulcerated surface of the cancer corresponds exactly in position with the neighbouring teeth, although the latter may be neither irregular nor carious. In such cases, great relief will be given by administering an anæsthetic and extracting all the teeth (sound or unsound) which touch, or in future are likely to touch, the cancerous mass.

(2) In cases in which the pain seems, from its character and distribution, to be caused by pressure on the gustatory nerve, great relief may be afforded by division of the latter in the manner recommended by Hilton or by C. H. Moore. *See* Gustatory Nerve.

(3) Among minor measures for the relief of pain may be mentioned the frequent cleansing of the mouth with lotions containing permanganate of potash, carbolic acid, or the like. Sometimes a lotion of citric acid (gr. x.–ʒss. to fʒj. of water) is serviceable, or the same remedy may be used in the form of small slices of lemon. Iodoform may be also occasionally dusted on the ulcerating surface.

(4) In some instances, acute pain at particular spots may be relieved by the application of the actual cautery, which acts, doubtless, by the destruction of fine nerve-filaments which are exposed in the course of the ulcerating process. For that purpose the cautery should be used at a dull-red heat, so that hæmorrhage may not be produced by the too quick destruction of the parts to which it is applied.

(5) Insufflation of the surface of the painful part with some such powder as the following has been lately strongly recommended by Butlin:—Borax, gr. iij. or gr. iv.; iodoform, gr. j.; morphia, gr. $\frac{1}{6}$ to gr. $\frac{1}{2}$.

(6) As a rule, the application of ice and of gentle pressure will suffice for moderate hæmorrhage from an ulcerated cancerous surface within the mouth, aided, if necessary, by some styptic, as perchloride of iron, carefully applied to the bleeding spot. It but rarely happens that ligature of the lingual artery is demanded.

The internal administration of opium and of other narcotics needs no detailed description. The surgeon must be guided by the special needs of each case.

W. Morrant Baker.

TONGUE, Operations for removal of the.—When the amount of disease is very small, and in the anterior part of the tongue, the method of removal is very simple. A strong thread should be passed through the tongue about an inch behind the tip, on the side opposite to that affected, and the little tumour or ulcer, having been seized by vulsellum forceps, may be cut out, with a good margin of healthy tissue, by the knife or strong curved scissors. If the operator prefer it, he may use the écraseur, taking care to pass one or more stout curved needles at a good distance behind the disease and in front of the écraseur, so as to ensure a free removal. In most cases, however, a less simple proceeding is required.

In choosing from among the various operations which have been recommended for removal of all but the smallest cancers of the tongue, the surgeon should adopt that which, in his opinion, will best enable him to remove the disease completely, without undue danger to the life of the patient.

Space admits here of a description only of those operations which are now usually practised.

(1) For the majority of cases the writer believes that the following method, which he suggested in the *Lancet*, April 10, 1880, is the best:—After the introduction of a suitable gag, and the removal of any sharp or jagged teeth which might be in the way of the operator, two threads are passed through the tongue about an inch behind the tip and half an inch on each side of the middle line. The tongue being now drawn forwards and upwards, the frænum and, as far as it may seem necessary, some of the muscular attachments of the tongue to the lower jaw in front are now snipped through, as advised by Sir James Paget, with strong, blunt-pointed scissors; and the scissors are then 'run' along the floor of the mouth at the side, beneath the mucous membrane, as far back as may seem requisite, keeping close to the lower jaw both for the avoidance of hæmorrhage and for the sake of being clear of the disease. The operator now with his forefinger clears the tongue in front and at the sides, and drawing it well forward again, and giving one thread to his assistant while he holds the other himself, he cuts steadily along the middle line of the tongue from the tip backwards, and farthest along the mucous membrane. On the withdrawal of the knife the finger is now again introduced, and it will be found quite easy to complete with it the median division of the tongue by a little tearing or splitting between the two halves. The only part which cannot be thus torn is the mucous membrane of the dorsum. Hence

the advice just given to divide this with the knife as far as may seem necessary for getting beyond the level of the disease. The écraseur is now slipped over the diseased half of the tongue. This is, of course, one of the most important parts of the operation; any want of care at this stage being shown afterwards by the narrow margin of healthy tissue, or by none at all, left attached to the diseased mass. The insertion of one or of two curved needles well behind the disease before the application of the écraseur in order to ensure the division of healthy tissue, is advisable, but, for the reasons previously given, must not be considered a sufficient safeguard in the absence of free separation of the tongue's attachments in front and at the sides. When one half of the tongue has been removed, the process is repeated on the other.

In a case in which the surgeon proposes to remove only half the tongue, the median section should be made before the attachments in front and on the diseased side are divided, as, of course, they need not be disturbed on the healthy side. The écraseur employed should be one curved 'on the flat,' and strong whipcord will be found more serviceable than the linked chain, which, from working only in one plane or nearly so, is much less readily looped far back.

In all cases in which, from the extent of the disease backward or in the floor of the mouth, any difficulty is anticipated in placing the loop of the écraseur well beyond the tumour, the cheek may be divided, with advantage, by an incision extending from the front border of the masseter to the angle of the mouth, as recommended by Gant and others.

Very commonly, at least when whipcord is employed, the main vessel and some other tissues, perhaps nerve-fibres, are pulled through the end of the écraseur after the softer substance of the tongue has been cut through. Under these circumstances, a double ligature should be passed with an aneurism needle, and the strand of vessels and nerves divided between the two knots, when the écraseur will, of course, at once come away, and the main vessels will be left on the face of the stump securely ligatured; or, if whipcord has been used, this may be cut through, and a single ligature applied to the small stump remaining.

After the removal of the tongue, wholly or in part, as the case may be, it should be carefully examined with reference to the question of how much healthy tissue has been removed with the cancer; and the floor of the mouth and stump of the tongue should be carefully examined also, with the same object in view. In freeing the tongue from the floor of the mouth, portions of mucous membrane, sublingual glands, and the like, are often loosened; and these can be readily dissected away when space has been gained by removal of the tongue. Lymphatic glands should also be searched for, especially in the submaxillary fossa. Should any be found, now or previously, an incision should be made through the skin and other parts over them, and they should be carefully enucleated.

It is often advisable, especially when the disease has advanced into the mucous membrane of the floor of the mouth, to extract three or four of the neighbouring teeth from the lower jaw; and, when the disease approaches or invades the gum, much valuable space may be gained (much more than would be imagined by one who has not done it) by cutting away also a portion of the alveolar border of the lower jaw.

In cases in which the tongue is adherent to neighbouring parts, the clearing of the diseased from the healthy tissues is the most important part of the operation; and nothing helps so much towards this end as a free median division of the tongue. The difficulties are at least halved by this procedure. If the disease is found to have been not quite completely removed, any nodules left may be carefully dissected out either entire, or sufficiently to enable a strong silk ligature to be passed beyond them, as in the case of lymphatic cancerous nodules high up in an axilla.

Notwithstanding every precaution, troublesome and even profuse hæmorrhage may occur during an operation for removal of the tongue. If the hæmorrhage is of alarming extent, or at least sufficient to fill the mouth so rapidly with blood as to make it impossible to see whence the bleeding comes, it is an excellent plan to pass the forefinger into the mouth, as far back as possible, and hook forward the base of the tongue, as if to press it against the inner surface of the lower jaw, behind the symphysis. This plan (suggested by Mr. Christopher Heath) has been found by the writer very serviceable on more than one occasion, the hæmorrhage being at once controlled, and the surgeon gaining time for seizing with forceps the base of the tongue (if not otherwise held), and for bringing the parts forward so as to be able to see and catch the bleeding vessel. At the same time, the head should be rolled over to one side, so as to give opportunity for escape to the blood which may have accumulated

in the back of the mouth. Difficulties in seizing a bleeding lingual artery usually arise from momentary forgetfulness, on the part of the surgeon, that the part whence the hæmorrhage comes, unless firmly held and drawn forwards, will be retracted out of easy reach at every attempt to nip the bleeding point with forceps.

(2) *Whitehead's Operation.*—The operation for removal of the tongue suggested by Mr. Walter Whitehead is performed by dividing the muscular and other attachments of the organ by scissors. A gag having been introduced, and the tongue steadily drawn forwards and upwards by means of a thread passed through its substance, the operator snips the frænum and mucous membrane of the floor of the mouth, and subsequently the muscular attachments of the tongue, by means of scissors, until all the attachments excepting the glosso-epiglottidean folds of mucous membrane have been divided. The latter are then finally cut through, after passing a thread through the tissues immediately in front of the epiglottis, which is retained *in situ*, for a day or two, as a means of drawing the stump forward, if required on account of hæmorrhage or of falling back of the epiglottis over the upper opening of the larynx.

This is, the writer believes, a satisfactory operation in cases in which the disease is not far enough advanced to have caused adhesions to neighbouring parts, and in which the surgeon can depend on having a good light and a skilled assistant, and in which the jaws can be opened to a width sufficient for obtaining a clear view of the tissues as they are successively divided throughout the whole course of the operation. But in such cases the operation previously described can also be easily and rapidly performed. The choice, therefore, of the one method over the other will depend very much on the liking of the surgeon for the scissors or the écraseur. In many cases, a preliminary division of the tongue along the middle line will be found very serviceable when the scissors are used; and when one-half of the tongue has been removed by the écraseur, so much space will have been gained, and all the tissues are so clearly within view, that a few snips with the scissors are, in some cases, all that is required for the removal of the second half and the completion of the operation.

In the performance of Whitehead's operation the details, as laid down by him, should be carefully attended to; a neglect of them having much to do with the troubles, as to hæmorrhage, which have been sometimes met with. One of the most important of these is the steady traction of the tongue out of the mouth, which should be unintermittent, and which not only brings each part well into view before division, but does much in restraining hæmorrhage.

In cases in which the tongue is adherent to neighbouring parts, so that it cannot be well drawn forwards, or in which the floor of the mouth is invaded by the disease; or in which a full view of the parts cannot be obtained, either from defective light or difficulty in opening the mouth, or restlessness of the patient from imperfect anæsthesia, the surgeon will do well to choose some other operation than cutting by scissors. Under the conditions referred to, an unfortunate snip of the lingual artery or one of its branches may lead to the filling of the mouth with blood, by which everything is obscured; while there may be inability to seize the bleeding vessel until the patient is faint from loss of blood, or has become half-suffocated by its entrance into the trachea.

There are no facts to warrant the conclusion that the wound left by the crushing action of the écraseur is less safe with regard to septicæmia than that left by the knife or scissors.

The plan of cutting down on the lingual artery (one or both) and applying a ligature to it, as a preliminary measure to removal of the tongue, is recommended by some surgeons. In most cases this is quite unnecessary.

Cases are sometimes met with in which the cancer has become closely adherent to the lower jaw, but in which the extent of the disease is not so great as to forbid an operation. In such instances a portion of the lower jaw may be removed; either a part of the alveolar border only, or a portion of the whole thickness of the horizontal ramus. Usually, in a case fit for operation, the anterior part of the jaw is the portion involved, and can be readily reached by making a vertical incision through the lower lip and down to the lower edge of the jaw, and then another cut at right angles to this (making with it either a ⊥ or ⌊ shape as may be required.) The flap or flaps are then dissected up from the bone, and the latter is deeply notched at two points with a saw, and the section completed with strong bone-forceps. The loose piece of bone, with the adherent mass of disease and more or less of the tongue, according to the extent of the cancer, is then removed. As all the parts are well within sight and reach, the knife, scissors, or écraseur may

be used, according to the fancy of the operator. The stump of the tongue should be firmly held during the division of the organ by means of a thread previously passed through it, so as to prevent it from falling back and interfering with respiration; the thread or a stout silver wire being afterwards fastened to the jaw or lower lip, and left in for a day or two.

(3) *Syme's Operation.*—This operation is performed by making a vertical median incision through the lower lip and chin down to the hyoid bone, and, after dissecting back the soft parts, dividing the lower jaw and separating the two halves, so as to expose the parts freely. The attachments of the tongue in front are then divided, and the organ removed by the knife. Unless the extent of the disease forbids it, the tongue should be divided along the middle line, as suggested by Buchanan of Glasgow, and only the diseased half removed. By these means one great source of danger after Syme's operation—the complete division of the muscles which attach the hyoid bone to the lower jaw—is avoided.

(4) *Regnoli's Operation.*—This operation is performed by making a semilunar incision immediately behind the horizontal ramus of the lower jaw, the horns of the incision extending nearly to the angles. An incision perpendicular to this is then made in the middle line from the centre of the first incision to the hyoid bone; and the two triangular flaps of integument thus outlined are dissected up, the surgeon taking care to avoid the facial arteries. The anterior bellies of the digastric muscles are now divided, and subsequently the attachments to the lower jaw of the genio-hyoids and genio-hyoglossi.

The mucous membrane of the floor of the mouth is now divided to an extent corresponding with the external wound; and, the tip of the tongue having been seized, the whole organ is drawn out through the incision and removed by dividing its attachments close to the hyoid bone.

This operation is now but seldom performed, as it possesses no advantage over the improved methods of removing the tongue through the open mouth, while it is a much more severe and troublesome proceeding.

(5) *Kocher's Operation.*—In this operation, as in Regnoli's, the tongue is removed through an infra-maxillary wound. An incision is made from a little above and behind the angle of the lower jaw, along the anterior border of the sterno-mastoid muscle to the level of the hyoid bone, then forwards to the latter, and is continued along the anterior belly of the digastric muscle. The flap having been turned up, the surgeon proceeds to tie the lingual artery, and to remove the lymphatic glands and other structures which lie in the neighbourhood. The tongue is then removed. It is recommended by those who practise this operation that, as a preliminary measure, tracheotomy should be performed, and that during the operation the pharynx should be plugged by a large sponge. The operation is a severe one, and its performance can only be justified by the results (as to non-recurrence of the cancer) being proved much better than after the less dangerous methods of operating.

The tongue is now but rarely removed by means of the galvanic wire or other form of actual cautery, on account of the greater amount of sloughing and the greater liability to secondary hæmorrhage which are entailed by this procedure.

After-treatment. — Immediately after the operation iodoform should be applied to the raw surface of the wound and adjacent parts; and, as soon as the patient has sufficiently recovered from the anæsthetic, he should be warned to let all saliva and 'discharge' escape from the mouth, and to refrain from any attempts at swallowing. The mouth should be rinsed frequently with a weak lotion of permanganate of potash or of carbolic acid (about one part to a hundred of water.) Small pieces of ice should be placed occasionally in the mouth, especially if there is any tendency to bleeding. The application of iodoform should be repeated daily if the mouth become foul.

If slight hæmorrhage recur after the operation, it will be found, as a rule, easily controllable by ice or by syringing the mouth with ice-cold water; or a piece of dry lint or sponge may be applied to the bleeding surface, and held firmly there for a few minutes by the finger of a nurse or assistant. If the hæmorrhage occur from a vessel of notable size, it should be, of course, seized with forceps and ligatured; and, in order to effect this, the *first* thing to be done is to seize the stump of the tongue with strong forceps and draw it forwards, so as to bring the bleeding vessel within sight and reach.

In almost all cases the patient should be fed for a few days through a tube. A No. 10 or 12 red-rubber or black elastic catheter, fitted with five or six inches of thin elastic tubing sufficiently large to admit the end of a glass funnel, is all the

apparatus required. The catheter can be easily introduced through the open mouth and passed to a point about half-way down the œsophagus, when the fluid nourishment, thus untainted by the 'discharge' from the mouth, can be poured into the funnel in any quantity that may be necessary. In the same way a dose of castor oil or saline aperient may be administered on the day following the operation.

Nutrient enemata and suppositories may, of course, be administered, if there is any insuperable objection to the use of the tube. W. Morrant Baker.

TONGUE-TIE. *See* Tongue, Diseases of the.

TONSILS, Diseases of the.—The tonsils are composed of lymphoid tissue, covered on the buccal side by a mucous membrane continuous with that of the pillars of the fauces. Externally, they rest upon the superior constrictors, which separate them from the internal carotid and ascending pharyngeal arteries; and they are in close relationship, posteriorly and above, with the pharyngeal orifices of the Eustachian tubes. The internal carotid artery lies from one-half to four-fifths of an inch behind and to the outer side, and is hence in little danger of injury during the puncture or abscission of the gland.

The physiological variations of the tonsil in size and aspect are very considerable. It may encroach sensibly upon the isthmus of the fauces, or may be so shrunken as to have the appearance of a shallow sulcus between the two pillars; and the surface may be almost smooth, or deeply honeycombed with crypts, the orifices of which occasionally present small pellets of retained secretion.

The principal diseases of the tonsils are acute and chronic inflammations, syphilitic and tubercular lesions, and tumours of various kinds.

Acute inflammation may assume two forms—the erythematous or catarrhal, and the phlegmonous.

Erythematous Tonsillitis is most common in early life, between the ages of five and twenty-five, and is especially prone to occur in rheumatic subjects. It is often epidemic, and may possibly be capable of spreading by infection.

The two chief causes are atmospheric contamination from bad drainage, and exposure to cold and damp. Erysipelas, measles, scarlet fever, syphilis, and belladonna-poisoning may also be associated with a symptomatic tonsillar erythema.

Symptoms.—The inflammation usually commences with a feeling of dryness and soreness of the mucous membrane of the tonsils and adjacent parts, associated with pain and a sense of stiffness of the parts on swallowing, and the expectoration of small quantities of viscid mucus. The affected gland is swollen, and at first red and dry in aspect, but may soon become covered with a thin pultaceous layer of epithelial débris, or studded with accumulations of pus in the glandular crypts ('follicular tonsillitis'), and the morbid condition may spread to the neighbouring parts. If the orifice of the Eustachian tube be reached, the complication is often indicated by a curious sense of irritation and tickling extending into the tympanum and external meatus, or, should the mischief go further, some dulness of hearing or even an active inflammation of the middle ear may supervene.

The constitutional symptoms bear no constant relation in degree to the local signs. More or less febrile disturbance is commonly present at the onset, and, where the affection is due to the inhalation of contaminated air, the nature of the evil may often be conjectured by the daily recurrence of profound mental depression, associated with a marked exacerbation of the local soreness and pain, on waking in the early morning; while food and pure air afford relief. Temporary albuminuria has been observed in some instances.

The disease, unless prolonged by the persistence of the cause, tends to subside in the course of the second week; but in unfavourable cases may pass into the phlegmonous form.

Treatment.—The occurrence of tonsillitis, especially in the follicular form, should always lead to a careful examination of the drainage of the house in which the patient resides, or of that in which he is occupied during hours of business. Should this be defective, the treatment of the symptoms will be of little service until the source of danger is removed.

Several remedies have been found useful as abortives at the onset of the disease. The chief of these are—(1) an emetic of ipecacuanha; (2) quinine in five-grain doses, repeated two or three times at intervals of a quarter of an hour; (3) salicylate of soda, in doses of fifteen grains, every three hours; (4) large and repeated doses of tincture of perchloride of iron (thirty to sixty minims); and (5) local application of bicarbonate of soda with the finger, or by insufflation five or six times in succession, at intervals of five minutes. If the affec-

tion pass on to the later stages, astringent gargles may be prescribed, the voice must be kept at rest, and the patient should be directed to breathe through the nose. Bland but nutritious food and pure air of equable temperature are important adjuncts to the medicinal and local measures.

Phlegmonous Tonsillitis (*Quinsy*).—The causes are those of the erythematous form, of which it is usually a sequel. In debilitated and overworked subjects it may develop under slight exciting causes.

Symptoms.—The condition begins as in the catarrhal affection, but the redness and swelling are more severe, and the inflammation usually becomes localised to a single gland. With the increase and diffusion of the inflammation are associated considerable pain and dysphagia, the respiration may be impeded, and the voice becomes changed. Tinnitus or partial deafness, spasmodic closure of the jaws, suffocative paroxysms, and enlargement of the submaxillary glands may appear as complications. There is tenderness on pressure externally opposite to the angle of the jaw, but any enlargement detected in this region is probably due to implication of the submaxillary lymphatic glands and not to the swelling of the tonsil itself.

Fever of variable degrees of intensity may accompany the local signs, and is generally associated with debility and mental depression.

When suppuration takes place the abscess may be single or multiple, and usually points inwards and forwards; but the pus may find its way towards the soft palate, or, in rare cases, may reach the suprahyoid region, or even show itself above the clavicle. The 'quinsy' of adults is commonly a suppurative inflammation of the areolar tissue of the soft palate or pharynx, rather than of the tonsil itself.

Treatment.—In the early stages, the treatment recommended for the erythematous affection may be sufficient. When abscess forms, the pus should be evacuated without delay by means of a bistoury guarded with a turn of strapping down to within half an inch of the point, and held with its cutting edge upwards and inwards (away from the internal carotid artery). Special instruments have been devised to add to the safety of the incision, but with ordinary care the armament of the pocket-case will be found quite sufficient.

The local application of cocaine may be of value as an alleviative in the acute stage of inflammation, and as an anæsthetic, before the incision of an abscess.

Hypertrophy of the Tonsils (*Chronic Tonsillitis.*)—The pure hypertrophy of the tonsils depends upon an increase of the lymphatic elements; but this condition is almost invariably associated with intercurrent attacks of subacute and chronic inflammation, which may lead to dilatation of the vessels and some induration of the connective tissue of the gland. It is nearly always bilateral, although mostly unequal in development on the two sides.

It is most common in strumous and lymphatic subjects, and is almost confined to the earlier years of life.

Symptoms.—The tonsils, usually as a sequel of repeated catarrhal inflammation, become enlarged, and project more or less into the isthmus of the fauces, in some cases even coming into contact with each other. The surface in the quiescent state is of a pale rose tint, but during an inflammatory access may be red and congested, and is often dotted with whitish granulations about the size of millet-seeds. The submaxillary lymphatic glands may be secondarily enlarged. Pain is usually slight or absent, but deglutition is impaired, the voice becomes altered, and, where the hypertrophy is considerable, the respiration may become so gravely embarrassed that sleep is repeatedly broken by suffocative paroxysms, the blood becomes imperfectly aërated, and the general nutrition suffers. In association with this, the aspect of the patient, if a child, may undergo a characteristic and remarkable change: the chest becomes contracted, the mouth is kept open to allow freer ingress of air to the lungs, and the countenance assumes a vacant and fatuous expression—a peculiarity which is increased when, as frequently occurs, the hearing becomes impaired through extension of the inflammatory processes to the Eustachian tubes.

The condition is usually associated with a predisposition to coryza and bronchial catarrh. Its course is very chronic, and it may linger on from childhood to puberty or even into early adult life.

Treatment.—The constitutional measures should be adapted in great measure to the diathesis. As a rule, cod-liver oil, pancreatic emulsion, and ferruginous tonics are the most efficacious medicines; but pure air, suitable exercise, and well-regulated, well-selected food are of still greater importance.

Locally, the use of astringent gargles or the direct application of powdered alum may be essayed. Should this fail and the condition demand more active treatment,

the enlarged gland may be pierced with a point of galvano-cautery, or the redundancy may be excised.

The ablation of the tonsil may be effected by a stroke of the bistoury, by the use of special instruments, or with the finger-nail. The so-called 'Borelli's operation,' avulsion by means of the finger-nail, is now practically abandoned, as liable to prove more painful and dangerous than any other method of removal. The use of the knife is still advocated by many surgeons. The most eligible instrument of the kind is a blunt-pointed bistoury, guarded by a turn of lint or strapping to within about three-quarters of an inch of the extremity; the cutting edge must be turned upwards and inwards, and manipulated while the gland is held with a pair of vulsellum-forceps. The guillotine, however, affords the safest and the most ready means of effecting the object. Many forms of this instrument have been devised, all answering the purpose more or less satisfactorily, but one of the best is that manufactured by Collin, which is provided with a kind of fork for transfixing and drawing inwards the gland at the moment of section. The operation is most easily effected when the surgeon stands behind the patient, whose head is to be well thrown back, but it may be performed with little less facility from the front.

The only danger to be feared in connexion with tonsillotomy is that of hæmorrhage. As a rule the loss of blood is very trifling in amount, but occasionally it is copious, and in one or two instances has even proved fatal. It may follow immediately upon the operation or occur after an interval of some hours, and is probably due to the implication of supplying vessels, that have become enlarged as a result of chronic hyperæmia of the gland; at any rate the flow is very rarely derived from the internal carotid artery, which can scarcely be wounded by any possibility with the guillotine, and only in the event of culpable neglect when the knife is employed. If severe, the bleeding may be arrested most conveniently by direct compression with a piece of lint, that has been soaked in a solution of perchloride of iron and wrapped around the handle of a spoon. The atrophy of the testicles, formerly supposed to be a possible consequence of the removal of the tonsils, is a contingency that need scarcely be taken into consideration. In the rare cases where such a condition has been observed after the operation, it has more probably been attributable to impaired nutrition induced by the disease, before the treatment was carried into effect. Excessive mental depression, which has been known to culminate in suicide, appears, however, to be a real danger, but is one for which it is not easy to find an explanation, unless we infer with Dr. Rubio the existence of a pharyngeal reflex, analogous in its nature and results to the well-known anal reflex.

Ulceration of the tonsils may be syphilitic, tubercular, or epitheliomatous in origin, or may develop symptomatically in the course of scarlet fever, diphtheria, &c.

Tonsillar Calculus consists of a concretion of phosphate and carbonate of lime, very similar in character to the tartar upon the teeth, and is found in the normal crypts of the gland. It may reach the size of a pea or small bean.

Tubercular Lesions.—Tuberculosis of the tonsil may appear in two forms, as (1) miliary granulations, which may follow an acute or chronic course; or as (2) an irregular ulcer of no great depth, characterised by the absence of induration, and the presence of tubercular matter in the borders and base of the sore. As a rule, neither condition is limited to the gland.

Syphilitic Lesions.—A few cases of hard chancre of the tonsil have been reported in recent years, but the complaint is very rare; secondary and tertiary lesions, however, in the form of mucous tubercles and gummatous ulcers, are amongst the most frequent manifestations of the disease. See *Syphilitic Stomatitis*, under Stomatitis; Syphilis.

Tumours.—*Hydatid cysts*, *fibromata*, and *myeloid* tumours have been met with in exceptional cases. *Sarcoma* is less uncommon, and generally takes the form of lympho-sarcoma. In nine cases collected by Mr. Butlin, the ages of the patients ranged between seventeen and fifty-three. In all, the disease had extended to the cervical glands, but only to those in immediate proximity to the growth; and in three instances in which post-mortem examinations were performed, a secondary affection of the viscera was demonstrated. Two new cases were added to the list by Mr. Clutton and Mr. Balding in 1884.

The removal of the growth by excision is a formidable operation, but has been undertaken with success. Out of seven published examples, death from hæmorrhage and exhaustion followed in one, cure is claimed in two, and in the rest a recurrence followed within a few months. The disease may sometimes be accessible from

the mouth with or without the division of the cheek, but in other cases it is necessary to expose the parts more fully by section of the inferior maxilla.

Epithelioma of the tonsil is seldom primary, but extends to the gland from adjacent parts. It may be scraped and cauterized with temporary advantage, and bold and extensive operations for removal of the disease by excision have recently been accomplished with success by Polaillon, Golding-Bird, and others.

The most frequent primary cancer of the part is *encephaloid*, while *scirrhus* is extremely rare. These affections have hitherto escaped the knife, but if seen at a sufficiently early stage might be treated in the same manner as sarcoma.

WILLIAM ANDERSON.

TOOTHACHE may be due to irritation of the tooth-pulp itself or to inflammatory conditions external to the tooth, though in immediate contiguity with it. It is important to discriminate between the two sets of causes, for the means for relief differ widely. Pain arising from a living pulp varies much in character; often it is very intermittent, coming on in darts, especially at the outset, and, even when continuous, it is subject to paroxysms of greater intensity. When severe, it is generally of throbbing character, and the tooth is very sensitive to changes of temperature; cold, however, occasionally is a relief, heat almost invariably an aggravation of the pain. There will be little tenderness on tapping the tooth, and none on pressing the gum over its roots.

Sometimes, the pain is of a neuralgic type and not felt in the offending tooth, so that its cause can only be discovered by careful examination of the teeth. It is aggravated by fatigue, relieved by tonics, stimulants, food, &c.

Hence, in any case of doubt, the teeth should be successively tested by the application, first, of a hot instrument, then of a large piece of wool dipped in cold water. If no sensation of pain results from these abrupt alternations of temperature, it is possible that the nerve is dead or dying, so that evidence of inflammation in the sockets should be sought by first smartly tapping the teeth in succession with the handle of an instrument of some weight, then pressing them home into their sockets, and, lastly, making firm pressure over the roots of each tooth. By such an examination, it will generally be possible to discover whether a tooth be the cause of pain or not, and to form an idea of its state if it be so.

If the pain be due to inflammation surrounding the tooth, the nerve will usually, though not quite invariably, be dead; there will be much tenderness elicited by tapping, or by pressure over the roots, and none by the test of heat and cold; if it has lasted long there will be swelling of the gums and more or less febrile disturbance. *See* GUM-BOIL. The cavity of decay should be cleared out, or, if it have been filled, the filling should be removed, so as to give free access to the pulp-cavity, and a little creasote, camphorated spirit, or oil of cloves is to be pumped down the roots; but the tooth must then be left perfectly open, so that pus or exudation can easily drain away. In the early stages, the gums over the roots should be painted with equal parts of tinctures of iodine and aconite; in the later stages deeply lanced.

If, on the other hand, we have to deal with a living pulp, and the pain have been of short duration and not very severe, the tooth should be closed up with a dressing of oil of cloves, creasote, or carbolic acid, confined by a pledget of wool dipped in a solution of gum mastic or sandrach. If the pain have been very severe, it is probable that there is a tiny drop of pus in the pulp-chamber pressing on the remains of the pulp; the pulp-chamber must then be carefully opened up and a dressing of the same nature applied, but, though this will give relief, the pulp is sure to die, and the best thing is to at once destroy it by an application of arsenious acid. This, however, should only be applied by those well accustomed to the manipulation of teeth, as disastrous results in the way of sloughing of the gum, necrosis of the neighbouring alveolus, &c., may follow upon the escape of any arsenic from the cavity. For the relief of pain a dead tooth should be left quite open, a live tooth carefully closed up.

Other less frequent causes of toothache are irregular calcifications of the pulp, exostosis of the roots, and the inflammation which attends the loosening of the teeth in old age; in a modified form this is, however, often met with in middle life, and when it occurs thus prematurely, it runs a more acute course, with more pain, suppuration, and ill smell, but, on the other hand, is more amenable to treatment. Another cause of obscure toothache is difficult eruption of teeth, especially of the wisdom teeth, which may ultimately be attended with violent inflammation of the superincumbent gum and surrounding parts. In many cases there is an absolute want of space, and no permanent relief will be got

without the extraction of the wisdom tooth, or, if this be impossible, of the tooth in front of it. In the vast majority of cases it is easy to discover the cause of pain due to morbid conditions of the teeth; but it occasionally is very difficult, especially when there are many teeth the condition of which is such that they are possible, though not probable, causes. It must not be forgotten that the gum will sometimes heal completely over a diseased root, or so nearly completely that only very careful search will discover any fistula.

Old-standing inflammations may also sometimes have involved the nerve-trunk, and so leave a legacy of pain even after their removal; this seems most prone to happen with lower wisdom teeth, the apices of whose roots are so very close to the inferior dental canal. CHARLES TOMES.

TOOTH-TUMOUR. *See* ODONTOMA.

TORSION.—This method of arresting hæmorrhage from large or small vessels was introduced by Amussat in 1829, and in this country was prominently brought forward by Mr. Bryant in 1868. To its originator it was suggested by the fact that 'torn vessels do not bleed.'

Numerous experiments upon living animals, upon dead arteries, and its practice in amputations in man, show that the effect of torsion is to rupture the internal and middle coats, as in ligature. The coats, moreover, are incurved, and being stripped from the external, are turned into the lumen of the vessel, so that the broken edges look towards the heart. Coagulation taking place around and—when the incurvation has been less complete—between the ruptured coats, prevents at once the escape of blood. The inflammatory process uniting the edges and the subsequent changes in the clot are the same as in ligation.

There are two ways of employing torsion: the 'free' and the 'limited.' In the 'free' the vessel is held by the forceps a short distance from the end, either parallel with or transverse to its axis, and twisted round and round. The objection raised to this plan, that the vessel is rotated through a great portion of its length and not completely twisted at any point, has no foundation, for it has been abundantly shown that only that part of the artery immediately above the forceps is twisted, and effectually so. This is the method now usually adopted. In the 'limited,' the vessel is first drawn out of its sheath and fixed by forceps three-fourths of an inch from the divided end, while with a second pair the extremity is seized and freely twisted. Special forceps must be used. They have flat, parallel, finely serrated blades secured by a sliding catch.

Torsion of large vessels—e.g. the femoral—is best performed in the following way. The artery is taken up by a pair of dissecting forceps and drawn forwards, the surrounding tissues being pushed back by a second pair till sufficient room is made for the application of torsion-forceps across the vessel, about one-eighth of an inch from the divided end. The whole width of the vessel must be grasped. The forceps are now rotated (or swung round) at right angles to the axis of the vessel, six complete revolutions being sufficient for the femoral, and four for smaller vessels. It is the practice of some surgeons to take up the vessel longitudinally, and rotate the forceps round in the hand; but this does not seem to secure such effectual torsion as the plan described above, for the whole width of the vessel is not included in the grasp of the forceps. When the torsion has been effective and complete, a loss of resistance will be felt, owing to the rupture of the inner coats, and whether one turn more or less secures this result is a matter of indifference.

It is well to allow the forceps to remain attached for a few minutes while the coagulum is forming, the other vessels being secured meantime. On removing the forceps, the twisted end uncoils a few turns and retracts into the sheath and the surrounding tissues, by which it should be well covered. The writer has in this way secured the first part of the axillary, and on several occasions the femoral. As to its safety, it is only necessary to quote Mr. Bryant, who gives 200 consecutive amputations at Guy's Hospital, in all of which the main artery was twisted, without a single case of secondary hæmorrhage.

In closing smaller vessels, it is only necessary to simply seize the end and give it several rapid twists.

Torsion is chiefly of value in securing the large vessels, and, when successful immediately after its application, there is no fear of secondary hæmorrhage unless unhealthy suppuration exist in the wound. It is the practice of the writer and of several other surgeons to secure the main vessels by torsion and the smaller by catgut.

CHARTERS JAMES SYMONDS.

TORTICOLLIS (Wry-Neck).—Deviation of the neck from the right direction is caused primarily by contraction of the

sterno-mastoid muscle, in most instances; other muscles may be associated with the sterno-mastoid, particularly the trapezius, the splenius, and the scaleni. The levator anguli also helps in approximating the head and shoulder.

The back of the head is drawn down towards the shoulder of the affected side, the face and chin being directed towards the opposite shoulder. The affected side of the neck is concave, and a very definite hollow may be made out below the mastoid process; across it is stretched the tight band of the sterno-mastoid. The tissues of the affected side of the face are, in a marked case, imperfectly developed, even to the inferior maxilla itself; the mouth and eyelids are drawn down, and the expression is changed and characteristic. On examining the lower half of the sterno-mastoid, the sternal and clavicular pieces may be found rigidly contracted and distinct.

The cause of the contraction of the muscle may be found—(1) in the muscle itself; (2) it may be due to the irritation of cervical caries, to an inflammatory attack of the vertebræ, periosteum, ligaments, muscles, nerves, or connective tissue of the neck, or to the presence of an inflamed or suppurating gland. In these cases, the contraction of the sterno-mastoid will be as a reflex act through the spinal-accessory or the second cervical nerve. Or, the contraction may be due to (3) some central irritation in the brain or spinal cord.

(1) When the cause of the contraction is in the muscle itself, it is generally the result of a tearing of bundles of its fibres during parturition, in which case a hard and tender ovoid lump may have been noticed in the course of the muscle or of one of its heads of origin within a few days or weeks of birth. The lump may be of the size and shape of a filbert or small walnut.

At one time it was thought that these sterno-mastoid tumours were of syphilitic origin, but any association they may have with such congenital taint is but accidental; the condition is due to a partial rupture of the muscle during parturition. Often the tumour is found after a difficult labour, but the writer has met with a case of such tumour, in which parturition had been so rapid and easy that neither midwife nor doctor had assisted. The tumour consists of torn muscle, blood, and inflammatory effusion. The mass becomes smaller by absorption, but the cicatricial patch in the muscle undergoes a steady contraction, until the ear may almost touch the shoulder. In the fat, short-necked infant, both the tumour and the early deformity of the neck may pass unnoticed; but as the neck grows the deviation becomes conspicuous, as may also be the arrested growth of the corresponding side of the face. The writer has recently been treating a young man, in whose case all the links in the clinical report were complete. The mother said that his had been a 'cross-birth;' that when he was a week or two old a 'lump' was noticed in the course of the muscle; the torticollis was complete.

(2) When the deformity is due to cervical caries, it is generally associated with obscure pains which radiate about the shoulders, neck, or scalp, according to the distribution of the sensory nerves whose trunks emerge at the carious region, and thus are compressed by inflammatory products. In the early stages the disease is apt to elude correct diagnosis, the 'stiffness of the neck' and other equivocal symptoms being frequently ascribed, at least by parents, to 'rheumatism.' If the patient be young or unintelligent, the neuralgic pains in the occipital and parietal regions may be spoken of as 'headache.' Stiffness of the neck is an important symptom; the patient cannot turn the head without at the same time wheeling round his shoulders and trunk, nor can he nod or shake the head freely. Pressure on the top of the head causes distress. *See* Caries of the Spine. It is of the utmost importance that an early diagnosis be made, the treatment demanding extreme gentleness, firmness, and a long-continued patient supervision. The writer has seen wry-neck suddenly caused by an acute attack of ostitis and periostitis of the cervical vertebræ, the result of a severe wetting of the head and neck of a child. The head was drawn down towards the right shoulder, and thus steadied against disturbance. Pressure upon the spinous processes or upon the top of the head gave intense pain. Such a case demands leeches, fomentations, and absolute rest in bed, the head being steadied between sand-pillows.

Wry-neck, due to the reflex contraction of muscles from peripheral irritation of inflamed tissue of the neck or glandular abscess, will disappear on the subsidence of the primary trouble, though exercises such as those sketched below may prove of advantage. For the deviation of the neck in infancy, gentle frictions and frequent adjustments of the head, as a precautionary measure, should be undertaken. But when such measures prove inefficient, as they most likely would in the case of the growing child, or the adult, or in the wry-neck

caused by vertebral caries long since passed away, tenotomy, under an anæsthetic, may be required. For this purpose a slender, blunt-pointed blade should be passed cautiously beneath that part of the muscle which shows most prominently at the root of the neck, when the head is brought towards the straight line. The puncture of the skin is made about half an inch above the clavicle with a sharp-pointed tenotome: and then with the blunt knife every resisting band must be severed. The skin-puncture is covered with a small compress of dry lint and a bandage, the head being left in the old position until the wound is sound. After section of one head of origin of the muscle, the other may be found in need of division; in this case two separate punctures of the skin are desirable. A few days after the tenotomy, frictions and shampooings of the neck should be begun, and the patient should be drilled in exercises to raise the head and depress the shoulder. He should carry a weight in the hand, and at the same time incline the head away, so as to stretch to the utmost the concave side of the neck. This stretching should be kept up at night by his lying with the affected side of the face upon a firm pillow. With this treatment, combined with massage, no mechanical apparatus need be required for the straightening of the neck, even in the adult. The operation is not entirely devoid of risk; troublesome bleeding may occur from the accidental and unavoidable wound of a blood-vessel, and should a venous tributary be stretched across the course of the knife, air may enter the circulation. In either case a firm compress should be adjusted. After the division of the contracted muscle, various secondary bands of shortened fibrous tissue will assert themselves; these will rarely need division with a knife, they will yield to drilling and manipulation.

(3) When the deformity is due to some central nervous irritation, the treatment is often unsatisfactory. The spasmodic contraction may be jerking, irregular and convulsive, and never cease during the waking of the patient. It is most common in young adults 'whose families have seemed prone to other cerebro-spinal affections' (Little). The treatment will comprise the administration of bromide of potassium and tonics; the employment of the mind; and the use of galvanism and massage. Tenotomy would afford but temporary relief, and even the stretching of the spinal accessory nerve, or the resection of a piece of it, does not always end the trouble. The nerve may be found either on its entrance to or emergence from the sterno-mastoid. In the former case an incision is made along the anterior border of the muscle, starting from the mastoid process, and descending for about two inches. The external jugular vein would have to be drawn forwards; and the head being still further inclined towards the shoulder of the affected side, in order to slacken the sterno-mastoid, the anterior border of the muscle would be slightly raised and everted, and the nerve running obliquely into its substance would be recognised. About half an inch of it should be taken away.

Neuro-mimetic contraction of the sterno-mastoid is most likely to be met with in girls; its onset may be sudden, and the symptoms over-acted.

Wry-neck from the contraction of an extensive cicatrix (as after a severe burn) is best dealt with by massage and exercises.

EDMUND OWEN.

TOURNIQUETS are instruments which are employed to arrest or diminish the flow of blood along the arteries to the limbs. There are two classes of tourniquets; the principle of one of them is to constrict the whole limb and to arrest the circulation through the collateral vessels as well as through the main vessel of a limb, whilst that of the other is the accurate limitation of the pressure to the main vessel, so that the flow of blood through it alone may be slowed or arrested.

Those of the first kind are used to prevent bleeding during the performance of operations on the limbs, or as a temporary means of checking bleeding from wounds of the limbs. For the latter purpose, in cases of emergency, the original plan, invented by Morel, may be employed; it is to tie a cord or a piece of bandage round the limb and pass a stick beneath the cord, and then to turn it round and round until the cord is twisted up and tightened sufficiently to arrest the circulation.

The elastic tourniquets of the present day act in a similar manner.

Esmarch's tourniquet is a strong elastic cord or tube, the bore of which is very small; a hook is attached to one end of it and a chain to the other. In using this, and all tourniquets which constrict the entire limb, the limb should be bandaged or raised, in order to favour the return of the venous blood, and then the cord should be rapidly stretched and wound round the limb, the two ends going in opposite directions and being finally secured by fastening

the hook to one of the rings. If applied slowly, the veins would be first compressed, and the limb consequently would become congested. Sometimes the ends of Esmarch's tourniquets do not meet just as required, and so they have to be carried once more round the limb, upon which they exert an undue constriction. *See* ESMARCH'S BLOODLESS METHOD.

Various modifications of this instrument have been introduced, with the object of remedying the defect alluded to above and of facilitating the removal of the tourniquet. Foulis' catch is one of these. It consists of a piece of vulcanite, about an inch and a quarter long, three-quarters of an inch broad, and half an inch deep; it is perforated along its longest axis by two holes, having a diameter of about an eighth of an inch; one of these communicates with the surface of the pad along its whole length by means of a slit; the elastic cord is threaded through the other hole. The pad is placed over the vessel, and the limb is encircled with the cord once or twice, and finally both ends, still on the stretch, are forced into the slit in the pad; when the ends of the cord are relaxed, the increased thickness which results serves to secure them firmly in the catch. Davy has recently introduced a catch which acts like the one just described, but it can be secured more firmly in position; its long axis is placed in the line of the vessel, and the elastic cord, which runs in the opposite direction, keeps it steady. Ward Cousins has substituted a buckle for the catch. His tourniquet consists of an elastic cord folded upon itself so as to form a loop, the ends of which are attached to the buckle. In place of the teeth of the common buckle, the one used has a plate with a serrated edge, which is not sharp enough to bite into the india-rubber, but is rough enough to get a good grip on to it. To apply the tourniquet, the cord should be stretched tightly round the limb, and should be secured by drawing the loop through the buckle.

All the tourniquets composed of an elastic cord are open to the objection that the cord produces severe constriction of the limb; this may be obviated by employing a stout elastic band with a piece of tape attached to each end, or with a buckle like that above described fixed to it about a foot and a half from one end; when applied, it may be secured by tying the tapes together into a bow, or by drawing the end of the india-rubber band through the buckle.

A field-tourniquet constricts the entire limb. It consists of a metal plate, to which a small pad is attached, and of a piece of stout tape. The plate has a slit at each side, through which the tape can be passed, and each lateral border of it has three teeth projecting from it. To apply the tourniquet, the tape should be placed beneath the limb, and each end of it should be passed through one of the slits in the plate above mentioned. By pulling on the ends of the tape the pad is pressed against the vessel, and the pressure can be kept up by fixing the ends of the tape into the projecting teeth on each side of the plate.

Petit's tourniquet may be employed either to constrict the entire limb, or, if a pad be placed over the main artery, to compress the latter and, at the same time, exert some general compression. The instrument consists of two plates, which can be separated from one another by means of a screw; a piece of stout tape is threaded into the plates in such a way that separation of the plates will draw on the ends of the tape. To apply the tourniquet, the plates should be placed in contact, and the tape should be buckled round the limb tightly enough to hold the instrument in position. By turning the screw, the plates may be separated, and the limb and main vessel compressed. Petit's and field-tourniquets are useful instruments to keep loosely applied to a limb from which hæmorrhage is anticipated, as either of them may be readily tightened up by a nurse.

The second class of tourniquets—viz. those which are intended to compress the main vessel of the limb alone, are chiefly used in the treatment of aneurisms. They are as follows:—

Signoroni's horse-shoe tourniquet is intended chiefly for the brachial artery. It consists of two stout steel arms, carrying pads at their extremities, which can be approximated or removed from one another by turning an endless screw placed at the hinge of the instrument.

Lister's (known also as Pancoast's) tourniquet is intended for compressing the aorta or common iliac in the treatment of aneurism of these vessels, or during amputation at the hip-joint. It consists of a large horseshoe-shaped piece of iron, carrying a pad at one end and perforated at the other by a female screw, through which a rod carrying a pad, and provided with a male screw, is introduced. The pad is screwed down on to the aorta at its bifurcation, which takes place at the level of the highest point of the crest of the ilium; the pad is so fixed on to the rod, which bears it, that the latter can be turned round without causing the pad to revolve; and when

screwing the pad firmly home, it should be held on the vessel with the left hand whilst the screw is being turned by the right.

Skey's tourniquet is intended for compressing the common iliac or the brachial arteries. The whole instrument has an elliptical outline, and completely encircles the limb to which it is applied. It consists of two plates, which are connected together by quarter-circle steel bars, themselves composed of two pieces sliding one on the other, so that the size of the instrument can be reduced to the circumference of the limb to which it is applied. One of the plates above mentioned forms a pad, which should be placed behind the limb; in the other plate, a steel rod, having a pad, works in a similar manner to that described in Lister's tourniquet.

In the instruments above described, the pressure of the pad on to the vessel is maintained by the rigid force of a screw, and is accordingly most irksome if it be kept up for a long time, as is the case in the treatment of aneurisms. With the object of remedying this, Carte has, by a most ingenious contrivance, converted the rigid pressure of the screw into an elastic one; and so great is this improvement, that in the treatment of popliteal aneurisms by instrumental compression of the common and superficial femoral vessels, Carte's instrument should be used in preference to those already described.

Carte's compressors are adapted for compressing the common femoral artery in the groin and the superficial femoral at the apex of Scarpa's triangle. They possess two great advantages—(1) that the rod which carries the pad is fixed to the rest of the instrument by a ball-and-socket joint, which renders the pad less liable to shift from the artery during any slight movement of the patient; (2) that the pressure exerted by the instrument is an elastic one. In the old-fashioned compressors, the rod which carries the pad moves in the framework of the instrument by means of a screw. In Carte's compressor it moves up and down without a screw, but just above the supporting framework there are two plates; the lower of these is fixed to the framework, and, like the latter, allows the rod which bears the pad to move freely through it; the upper one only permits the rod to move through it by being screwed round. The two plates are joined together by a strong piece of elastic on each side. When the attempt is made to screw the pad down, the first effect is to separate the plates and put the elastic on the stretch; and it is only when the elastic is well stretched that the pad is pressed on to the vessel. If the pad be too tightly screwed down the elastic will be still more stretched, and so the pad will be allowed to rise a little from the limb and undue pressure will be relieved. Carte's larger instrument —viz. that for the groin—is fixed on to the pelvis by a broad and well-padded belt. The smaller instrument is very like Skey's tourniquet in shape, but its size cannot be altered as that one can.

Tuffnell's compressor consists of a truss-spring, with a pad which presses on the artery. It is fixed in position with straps, which also serve to press the pad more firmly on to the vessel. It is used for compressing the femoral artery.

Higginbottom's alveolar tourniquet is composed of two blades, with a pad at the end of each; its principle of action is like that of Signoroni's tourniquet. It is used to make pressure on bleeding tooth-sockets; this is accomplished by one of the blades within the mouth, whilst the other blade presses against the inferior border of the body of the lower jaw. A similar instrument is made for the upper jaw; one of its blades makes a wide sweep so as to fit on to the top of the head.

Weight-compressors are of two kinds. One consists of a conical bag with a truncated apex. The bag should be filled with shot and suspended over the vessel to be compressed, and steadied in position by the patient. The other (Watson's) consists of a weight, which is suspended from a Carte's elastic spring, and so adjusted that it rests upon the vessel. BILTON POLLARD.

TRACHEAL CATHETERISM.—The introduction of instruments through the mouth into the trachea was first attempted by Desault, who saw the immunity from evil following the accidental introduction of an œsophageal tube into the trachea, the tolerance with which the patient bore it, and the easy manner in which he respired through it. This took place toward the close of Desault's life, and he had few opportunities of practising the method. Efforts in the same direction were subsequently made by other surgeons, among whom was Bouchut, who practised what he termed *le tubage du larynx*, but who was so unfortunate as to be unable to record any case in which the life of the patient was saved by this method. Trendelenburg and Schrötter pass three-cornered vulcanite tubes into the larynx, in chronic cases, for purposes of dilatation. Since 1878 the writer has had

the opportunity of introducing tubes into the trachea through the mouth in a variety of cases, and the practice has been attended with favourable results.

It need scarcely be premised that, when it is practicable, a laryngoscopic examination ought to be made previous to passing the tracheal catheter. Some prefer to introduce the catheter by aid of the laryngoscopic mirror, while others are satisfied to be guided by the sensation of touch and an accurate anatomical knowledge of the parts. The catheters may be passed either with or without the aid of anæsthetics. Local anæsthesia, such as may be induced by the repeated painting of morphia solution on the outside of the larynx, or by the application of a solution of cocaine to the mucous membrane of the larynx, is of benefit in diminishing the sensitiveness of the parts, and preventing the troublesome expiratory efforts immediately following their introduction. Under chloroform, the introduction is attended by very little coughing, and a fresh whiff of the drug, inhaled through the tube, speedily allays any irritation which may have been set up. In a number of instances, the tubes have been passed by the writer without the aid of either local or general anæsthesia; both in cases where the larynx and trachea were in a normal physiological condition, the tubes having been passed in such instances in order to prevent blood from entering the trachea during operations about the mouth, and also in acute and chronic diseased conditions. In the former class of cases, when the patients were adults or were old enough to understand intelligently, the method of introducing the tube, and the sensations which its introduction gave rise to were explained to them, and they were invited to aid its introduction—first, by endeavouring to control coughing or retching; secondly, by being prepared to take a long inspiration at the moment of inserting the tube into the larynx; and thirdly, after the introduction of the tube, instead of persisting in violent expiratory efforts, to allow a deep inspiration to take place.

When the tube is about to be inserted, the patient's head is thrown well back, his mouth is opened, and if he be nervous a gag is introduced; in children this precaution is always taken. The tongue is then well drawn forward. The operator's left index-finger is introduced until it touches the epiglottis, which it depresses against the tongue. If the laryngoscopic mirror be used the epiglottis may be left free. The tracheal tube is made to pass over the index-finger, until it is engaged in the glottis, the patient being then instructed to take a long deep inspiration, and at the same moment the tube glides between the cords into the trachea. If the tube be made of hard rubber, the operation is now completed; if it consists of soft gum-elastic, the stylet used in introducing it is removed. The patient then gives vent to a series of prolonged expiratory efforts, which are generally greatly lessened after his first full inspiration. During the five minutes subsequent to its introduction, the cough may be very troublesome, but at the end of that period a tolerance has generally been established. A few inhalations of chloroform through the tube, at this stage, greatly mitigate the irritation.

There are considerable individual differences in the degree of toleration of the tube. In some diseased laryngeal conditions, the parts are by no means so sensitive as they are in health, and when once the tube is introduced, they are much more tolerant of its presence. The fact that the obstruction to the breathing has been overcome, gives the patient a sense of relief which causes him to regard the tube favourably. In one such case the patient was suffering from an advanced epitheliomatous affection of the larynx, and was in great distress from dyspnœa at the time he was first seen by the writer. After examining with the laryngoscope, a small-sized tracheal catheter was introduced while he stood in the theatre, its insertion being attended by very little coughing, and a few minutes afterwards he walked to his ward, steadying with his hand the extremity of the tube which projected from his mouth. It afforded him complete temporary relief, and enabled him to have a sound sleep, the first he had had for many days. In children the parts are soft and much more easily injured, and therefore the introduction of the tube must be undertaken with greater gentleness. There is also the difficulty to contend with, in the want of understanding on the part of the child; therefore the head requires to be held, and the gag to be introduced. A nurse is required to attend to the child afterwards, to prevent the tube from being removed.

In most cases it is better at first to insert a catheter of less calibre than the capacity of the larynx, as it will be admitted more readily, and subsequently a larger one may be inserted. In cases of dyspnœa, due to exudation about the glottis, the patient is able to breathe with freedom if the catheter be withdrawn at the end of

a few hours. The œdema is apt to return, however, and therefore it is better to retain the instrument in the trachea for ten or twelve hours. It may be withdrawn at the end of that period, and again inserted if the patient has any further respiratory difficulty. Not only can respiration be carried on through the catheter, but the patient has the power of expelling mucus or other secretion from the trachea beyond the distal extremity of the tube. He can swallow while the tube is in the larynx without any of the liquid gaining access to the trachea. When vomiting occurs, the ejected matters do not pass into the air-passages.

The catheter may be known to be in the respiratory passages from the sensation imparted by the tube passing over the first ring or two of the trachea; by the fact that there is a current of air flowing into the tube on inspiration and one passing out on expiration—the opposite being the case if it be in the œsophagus. A lighted taper or match will demonstrate these currents.

When the catheter is to be inserted to prevent blood from gaining access to the trachea during operations about the mouth or fauces, it should be mounted with a double fold of india-rubber tubing which fits firmly on the tube, and at the same time it should be sufficient to occlude the laryngeal orifice. This india-rubber ring may be about half an inch in length, and be placed about three inches from the proximal extremity of the tube. When this tube thus furnished is inserted into the trachea, the anæsthetic may be administered through it, the currents of air being distinctly audible to the chloroformist, who thus has a ready guide to the state of the respiration. The anæsthetic may be continuously administered during the whole time, without interfering with or stopping the operation. It answers the same purposes as Trendelenburg's tampon-canula, with the advantage of not complicating the major operation with tracheotomy or its after-results.

Tracheal catheters may be introduced in cases where the respiration is impeded by other than movable bodies, which might be pushed before the instruments further into the trachea. In cases of œdema glottidis and laryngeal stenosis, the presence of the catheter in the trachea for a few hours often gives great relief. If care be taken, the cords are not injured, the voice afterwards becoming quite restored. In cases of acute and severe laryngitis, tracheotomy is the better procedure. The introduction of the tube requires practice on the cadaver; when this can be accomplished on the dead body, it will be found easy to introduce it afterwards on the living.

William Macewen.

TRACHELORRHAPHY. *See* Emmet's Operation.

TRACHEOTOMY. — This operation may be defined as the artificial opening of the trachea, either to give entrance to air, or exit to foreign bodies; or for the purpose of gaining direct access to the windpipe for the removal of morbid growths. The operation is indicated in all cases where the free entrance of air to the lungs is interfered with, by a mechanical hindrance situated in the larynx or trachea.

Tracheotomy is now almost always preferred to Laryngotomy in cases where the impediment is likely to persist for any length of time. Thus, tracheotomy may be required in laryngeal diphtheria; in cancer and malignant disease of the larynx, both primary and secondary; in certain diseases affecting neighbouring parts, and causing pressure on or displacement of the trachea, such as goître, aneurism, or disease of the spine; for foreign bodies in the trachea or bronchi; and in some cases of laryngeal ulceration (for the purpose of giving rest to the cords), &c. In short, in all cases where life is threatened by a mechanical hindrance to respiration, which itself cannot be otherwise removed sufficiently rapidly, this operation is indicated. A consideration of the foregoing indications cannot fail to show that the operation must not, in any sense, be considered as a curative or therapeutic measure; it is but a means to an end, and the treatment, which may be appropriate to the various conditions calling for the operation, ought in no way to be suspended or interfered with after the operation has been performed.

The Operation.—*Seat of Incision.*—When the opening in the trachea is made above the level of the thyroid isthmus, the 'high operation' is spoken of; when the opening is below the isthmus, it is spoken of as the 'low operation.' For anatomical reasons, to be presently alluded to, the high operation should always be selected unless some contra-indication exists, especially in the case of children and short-necked persons. Many operations which are called tracheotomies would be more accurately described as crico-tracheotomies, for the reason that the cricoid cartilage participates in the incision.

Anatomy.—The trachea, owing to the large amount of soft cellular tissue by which

it is surrounded, is very movable. It is grasped between the lobes of the thyroid gland, and the isthmus which connects these lobes crosses its upper part, the whole gland being bound down upon the trachea by the deep layer of the cervical fascia. The isthmus of the gland (which is chiefly concerned in tracheotomy) varies much in size, being usually larger in females, and sometimes assuming very considerable proportions. In front of it is a large plexus of veins, which in all forms of pulmonary obstruction becomes gorged, and which, if cut during the operation, may cause troublesome hæmorrhage. The trachea runs downwards and backwards; it is therefore nearer the surface and more easily reached in the upper than in the lower part; hence the advantage of the high over the low operation. Moreover, besides its greater depth, the close proximity of the large vessels of the neck, as well as occasional abnormalities in their origin and course, render the low operation not only more difficult but more dangerous.

The *size of the trachea* varies; in young subjects it is disproportionately small, or, in other words, the larynx and trachea undergo special development after about the twelfth or fourteenth year of life. In twenty-four cases taken without selection, mostly from young subjects, male and female, the writer found the average diameter to be ·374 of an inch. The cases included one adult male, aged twenty, with a diameter of ·550; a boy, aged thirteen years, with ·475; and a girl, aged eleven years, with ·425. The average diameter of twenty cases, boys and girls of eight years and under, was ·356. These latter cases included an infant, aged ten weeks, with ·300; a boy, aged two years and two months, with ·275; a girl, aged three years and nine months, with ·500; also a girl, aged eight years, with ·500. Thus, the trachea varies in size with the growth and development of the child, rather than with its age. The above figures will give an idea of the size of the tube which may be required. In adults the differences in size are of less moment, as the trachea is larger in proportion to the body, and far larger than any tracheotomy-tube which can be required.

Various methods of operating have been proposed. Thus, a trocar and canula, suitably shaped, have been used by some surgeons, while others have tried the actual cautery; the ordinary plan of using a scalpel is the only method which will be described in this place. The surgeon will have first to decide whether an anæsthetic shall be administered or not. In a great many cases, especially in young children, an anæsthetic will be of the greatest service; if administered slowly and without constraining the patient too much, it never does harm. *See* Laryngotomy. If the patient is old enough, and has the courage to keep himself quiet, the anæsthetic may be dispensed with. The recumbent position is the most convenient for operating, with the head thrown back in order to make the trachea stand prominently forward. Then, with the index finger of the left hand the cricoid cartilage should be felt for and its exact position ascertained; in thin subjects there will be no difficulty, but in short, fleshy necks, especially if the thyroid gland or its isthmus is large, the cricoid cartilage is not always easy to make out.

An incision, having the cricoid about or a little above its centre, is now made in the median line of the neck, when the sterno-hyoid muscles, separated by a linear interval, will be seen through the superficial layer of the cervical fascia; the sterno-thyroid muscles are immediately beneath, also separated from each other by a narrow interval. The incision must next be carried through this interval, any veins which meanwhile present themselves being drawn aside. By keeping exactly in the median line, the danger of hæmorrhage is greatly lessened. After the muscles have been drawn aside by blunt hooks, the trachea will come into view; perhaps the thyroid isthmus, if very high or very large, may be found in front of the trachea. In the latter case it must be depressed by means of a blunt hook, after cutting through the fascia by which it is bound down to the trachea. Or the isthmus may be deliberately cut through, if it is seriously in the way and the case is an urgent one.

The trachea having been well exposed, the first three or four rings may be incised *from below upwards*. In young children, owing to the shortness of the neck, the space is very limited, and it will generally be found advantageous to include the cricoid cartilage in the incision, thus converting the operation into a crico-tracheotomy. It is very desirable that the opening should be as ample as possible, for besides facilitating the introduction of the tube, it gives better access to the trachea, and allows the surgeon to carry out his after-treatment with greater ease and certainty. The trachea having been incised, a dilator is introduced, and the opening kept patent. No further anæsthesia will be required; a

good deal of irritation and coughing usually ensues, by which mucus and any blood which may have penetrated are expelled.

The subsequent proceedings depend on the nature of the disease which has called for the operation, and will be discussed farther on *seriatim*. The introduction of the tube is usually accomplished without difficulty, provided a median and ample incision into the trachea has been made. As regards the *size* of the tube, it may be laid down that the largest tube which can be got into the trachea without violence, and the shortest which can be well retained, should be used.

The *shape* of the tube is of great moment. It has already been stated that the direction of the trachea is downwards and backwards. A quarter-circle tube is, therefore, obviously unsuited for the purpose. Some years ago the writer proposed, and has since extensively used, an 'angular tube;' this has been found to be comfortable to the patient, as well as free from the inconveniences which an ill-fitting quarter-circle tube so frequently gives rise to. In gauging the calibre, the inner tube must always be taken; the smallest diameter at any point determines the available size for breathing purposes; tapering tubes should always be avoided; the inner tube should project slightly beyond the outer. In a few urgent cases the patient ceases to breathe before the operation can be completed. When this occurs, the operator should complete the operation, put in the dilator, and having cleared away any mechanical impediments to respiration, should then practise artificial respiration. It is rare not to be able to re-establish respiration.

After-treatment. — This depends altogether on the nature of the lesion which has called for the operation. Undertaken for the removal of a foreign body, if not coughed out after the trachea is opened the foreign body must be searched for with suitably curved forceps, or a sling of bent silver wire, or a trachea-aspirator. Auscultation or the patient's sensations will probably indicate its position, and the surgeon will use the means which seem most appropriate to the individual case. After its withdrawal, the opening in the trachea need only be covered with wet lint, unless any secondary conditions in larynx, trachea, or lungs indicate that a tube should be worn. In the former case, the wound will probably heal in a few days; in the latter, recovery will be more gradual, and dependent on the nature and extent of the secondary lesions. *See* Foreign Bodies in the Air-Passages.

If the operation has been undertaken on account of respiratory obstruction due to papilloma in the larynx, a tube will have to be worn until the cause of the obstruction has been removed. If malignant growth have spread to the larynx or trachea, the tube will have to be worn indefinitely; the chief object of the after-treatment consisting in keeping the discharges as sweet as possible, and in facilitating their exit from the trachea.

This will be best accomplished by the application of disinfecting solutions or powders; among the former, glycerine of boracic acid, or of carbolic acid, or of alum will be found most useful; they may be applied through the tracheal opening with a soft brush or a feather; among the latter, iodoform blown in with an insufflator will be found efficacious. The use of a spray from time to time, the patient breathing it into the lung as much as possible, will help to ward off septic pneumonia, so fatal a complication in these cases. The occasional application to the eroded surfaces and adjoining part of a solution of cocaine will add much to the comfort of the patient, by diminishing pain and reflex irritability. In cases of paralysis of the laryngeal muscles; of injury to the larynx with secondary swelling or ecchymosis of the mucous and submucous tissues; of stricture following ulcerative processes, the tube will have to be worn until the condition causing the obstruction has passed or subsided. Besides keeping the tubes quite clean, no special after-treatment, as regards the tracheotomy wound, will be required. In all such cases great care must be used in selecting a well-fitting tube, or secondary ulceration may ensue.

It is in cases of diphtheria that after-treatment becomes of such special moment, not only because of the dangerous nature of this disease, but because children are the chief sufferers. If the purposes of the operation be kept in mind—viz. the admission of air into the lungs, and the removal of the false membrane (which is infective as well as obstructive)—the nature of the after-treatment will be obvious. Immediately after incising the trachea, while it is being held open by the dilator, and before the tube is put in, an effort must be made to clear out all membrane and retained secretions; for this purpose a good long feather answers admirably. After being soaked in a solution of sodium or potassium bicarbonate and glycerine (ʒij. and fʒj. respectively to half a pint of distilled water), this feather should be passed into the

trachea and twirled about so as to detach the membrane, that it may be coughed out; the feather may then be passed up into the larynx and through the glottis, and all membrane thoroughly cleaned out. This proceeding may have to be repeated several times. Besides the feathering, some of the potash solution may be sprayed into the wound; it will be found to moisten, dissolve, and detach secretions, and so aid their expulsion. In a few cases, even this does not suffice to clear the air-passages; then aspiration must be tried. This is most effectually accomplished with the writer's 'tracheal aspirator;' the plan, moreover, is free from danger. To suck a tracheotomy wound is worse than useless, for if the secretions are adherent they cannot be sucked out, and if they are loose they will be coughed out spontaneously. It is very necessary that the tubes be taken out and changed, the outer tube once in twenty-four hours, the inner tube every hour or two according to the amount and tenacity of the discharge.

It is a very useful practice to place all tracheotomised patients in a 'croup-bed'—that is to say, in a bed surrounded with thick curtains—and to keep the air warm and moist. For this purpose, Allen's croup-kettle, made at the suggestion of the writer, is the most simple and efficient means; by it the amount of heat, as well as of steam, can be nicely regulated; an excess of steam is injurious. One of the advantages of a 'croup-bed' is that the room can be thoroughly ventilated, without exposing the patient to any draught or change of temperature.

The *final removal of the tracheotomy tube* can only be thought of when the disease has been arrested or the foreign body removed. In malignant cases, in syphilitic disease, after injuries leading to cicatricial narrowing, a tube may have to be worn permanently. As a rule, in acute cases an attempt to dispense with the tube should be made about the fourth day, and repeated at longer or shorter intervals until the breathing through the natural channel can be re-established.

Complications.—These may be briefly described as *immediate* and *remote*. The former are more or less acute, coming on within a few hours or days of the operation, and may appropriately be called 'wound complications;' these include diphtheria of the wound, inflammatory œdema of the neck, and erysipelas. The latter are generally chronic, and include pharyngeal catarrh, laryngeal catarrh, irritative changes due to the presence of a tube, and ulceration due to an ill-fitting tube.

Immediate Complications.—Diphtheria of the tracheotomy wound is comparatively rare; a sloughy and unhealthy condition (which is sometimes mistaken for diphtheria) is very common. Trousseau, to obviate this tendency, recommended that 'during the first four days, the entire surface of the incision should be vigorously cauterised once a day; one may thus avoid a very redoubtable complication, the diphtheritic infection of the wound.' Should this really occur, active measures must be taken; the surface may be touched once or twice with a mixture of equal quantities of hydrochloric acid and of glycerine, whereby a simple will be substituted for a specific inflammation. The free use of the spray, and the application of glycerine of boracic acid, as previously recommended, are excellent prophylactic measures. Œdema of the neck is a much more frequent complication. To a small extent it occurs after all operations. Sometimes, owing to unusual difficulties in opening the trachea, the intermuscular planes are too freely opened up, and the cellulitis assumes dangerous proportions. It may or may not be complicated with erysipelas—that is to say, with involvement of the skin. Sometimes severe erysipelas occurs on the surface, without appearing to affect the deeper layers. In either case their occurrence adds to the gravity of the disease for which the operation has been undertaken. Treatment must be both local and general. As a local application, nothing answers so well as lactate of lead—one drachm of liq. plumbi to a fluid ounce of fresh milk—which should be brushed thickly over the inflamed parts, and be frequently renewed. Internally, quinine and iron should be given.

Remoter Complications. — Chronic pharyngitis, with or without enlargement of tonsils, not infrequently supervenes, in weakly subjects, on an attack of pharyngeal diphtheria or scald. The condition is chiefly of interest because it may interfere with the permanent removal of the tube. The most appropriate local treatment is alum, either in the form of a saturated spray, or with glycerine, which latter must be brushed on several times a day. Cod-liver oil and steel wine, alone or combined, should be given internally. Chronic laryngitis is another sequel, and one which often causes considerable delay in removing the tube; in these cases, there are stridor in

breathing, chiefly with inspiration, hoarseness of voice, and sometimes troublesome cough. Alum solution must be sprayed into the larynx, or glycerine of alum be applied with a laryngeal brush. Occasionally, it is advantageous to paint the vocal cords and neighbouring parts with a solution of nitrate of silver (10 to 20 grains to the fluid ounce of distilled water). This chronic laryngitis is sometimes kept up by, and may be due to, the irritation which the presence of a tube causes, even when the tube fits well, for some tracheæ are so hypersensitive that they never become habituated to the presence of the tube. In such cases every means must be adopted to lessen the irritation; the use of cocaine will prove of great value. Ulceration within the trachea, generally on the anterior wall, about the spot where the lower extremity of the tube impinges, was formerly a frequent complication after tracheotomy. Since M. Roger of Paris drew prominent attention to it, and to the part which ill-fitting tubes played in its production, ulceration has become much less frequent; the remedy for such cases is obvious. It must be stated, however, that complications are much less frequent in cases of injury or morbid growths requiring tracheotomy than in disease. *See* Tracheotomy Tubes.

Robert William Parker.

TRACHEOTOMY TUBES are employed to maintain a free passage for the entrance of air into the trachea, from an artificial opening in the neck, in cases where there is an obstruction to its entrance through the larynx. The tubes are made of either silver, india-rubber, vulcanite, or celluloid, and are fashioned according to numerous patterns.

There are several requisites in a good tracheotomy tube: it should be easy to introduce; it should be composed of two canulæ, one of which fits within the other, and projects a little beyond it at its deep extremity. The mucus which is so abundantly secreted in the trachea collects in successive layers within the tube, narrowing its calibre and impeding the passage of air through it. The mucus forms a coating of leathery consistence, which it is quite impossible to detach by means of a feather, and so it is frequently necessary to remove the canula in order to clear it away. If there were only one tube its removal might cause dyspnœa, and considerable difficulty might be experienced in replacing it; with the double tube this difficulty is overcome, for the patient can breathe through the outer tube whilst the inner one is being washed. The mucus adheres to the extremity of the tubes; so it is obvious that, if the inner tube were of the same length as the outer one, the mucus collected about the extremity of the latter would offer an obstruction, however clean the former were kept.

A good tracheotomy tube should inflict the least possible injury on the trachea; to ensure this, the portion of the tube within the trachea should lie exactly in the axis of that channel, so that the free extremity of the tube does not project against its walls. The tube should be capable of as little movement within the trachea as possible, and with this object it should be as large as can be got into the trachea without inflicting injury during its introduction. The shield, which is attached to the surface extremity of the tube in order to prevent it slipping into the trachea, should be movable, for, if it be rigidly fixed to the canula, any movements of the neck or of the trachea are liable to cause the canula to injure the mucous membrane. The inner canula ought to be capable of easy introduction and removal; if it fit tightly, there is some liability of injuring the trachea by pressing the outer tube against its posterior wall. This can be avoided if care be taken to support the outer tube by the fingers, whilst the inner one is pressed home with the thumbs, but, as the removal of the inner tube is often entrusted to nurses, it is desirable that it should slip in easily, without any forcible pressure.

Fuller's silver bivalve canula has been largely used. It is a quarter-circle tube, and is composed of two canulæ: the outer one is rigidly fixed to the shield, and is split down the middle so as to allow of its two halves being pressed together. This contrivance makes it easy to introduce the outer canula, but considerable force is required to push home the inner one, as it has to press the two valves apart and to dilate the opening in the trachea; in doing this, the sharp extremities of the outer canula will be pressed against the trachea, unless care be taken. Sankey has contrived a pair of forceps which still further facilitate the introduction of the outer canula; the blades of the forceps are passed through slits in the shield and made to grip the two valves and so compress them. Jessop has had the valves attached to the shield by means of a hinge, which allows of their being more easily separated; this modification lessens the pressure required to introduce the inner tube, and also facilitates the cleansing of the instrument.

The quarter-circle curve of these instruments is objectionable, as has been especially pointed out by R. W. Parker; he has shown that, when the tube is in the windpipe, the convex surface presses against the posterior wall of the trachea, whilst the front of the lower extremity of the tube tends to press on the anterior surface of the trachea, and set up ulceration at that site.

Durham's tracheotomy tubes are a great improvement on the quarter-circle canulæ. They are made of silver, and are only curved towards the lower end; they are provided with Roger's movable shields, and there is, further, a movable collar, to which the shield is attached, and which can be firmly clamped at any position along the straight portion of the tube. When in use, the portion of the tube beyond the curve should alone rest in the trachea, and to ensure this, the movable collar should be fixed at such a position as is required by the depth of the trachea from the surface. The shape of these tubes is such that a rigid inner canula could not be introduced, so the lower part of the latter is furnished with lobster-tail joints. A similarly jointed pilot, which projects with a blunt point just beyond the lower end of the outer tube, greatly facilitates the introduction of this instrument into the trachea.

Bryant's tracheotomy tube has a quarter-circle curve, but the intra-tracheal portion is freely movable with the trachea, owing to the canula being attached to the shield by a ball-and-socket joint.

R. W. Parker's tracheotomy tube is bent at an angle, which he has found, by examination on the subject, ensures its lying in the axis of the trachea. This is a most important modification, for by means of it the tendency of the tube to cause ulceration of the mucous membrane is reduced to a minimum. The tube is provided with an inner canula, which projects beyond the outer one; owing to the shape of this tube, a complete inner canula could not be introduced, so the latter is made without a posterior wall, except at the upper and lower extremities. The inner canula slips into position almost by its own weight, and can be firmly secured by a clip at the upper end. The instrument is provided with Roger's movable collar. It will be seen that this instrument possesses all the essential factors of a good tracheotomy tube.

Morrant Baker has introduced india-rubber tracheotomy tubes; they are made of vulcanised red india-rubber, and are sufficiently firm to withstand ordinary pressure, though not rigid enough to cause ulceration of the tracheal mucous membrane. These tubes are not intended to be used until twenty-four hours after the operation. Walsham has devised a pair of curved forceps, which can be passed along the tube and then opened so as to stretch it to the shape of the opening in the trachea, and thus facilitate its introduction.

Tracheotomy tubes should be securely tied into the trachea with a piece of tape. The tape should be threaded through a slit in one end of the shield, and the two ends of the tape should be carried behind the neck to the other side, where one end of the tape should be threaded through the slit in the other extremity of the shield, and then the two ends of the tape should be tied together at the side of the neck.

Difficulty is sometimes experienced in cleaning the inner canula; this is best done by pouring over it boiling water, to which some common salt has been added.

It is a difficult point to decide when a tracheotomy tube may be safely left out; some assistance may be gained by the employment of Lauer's ball-valve, which can be fitted to the orifice of the canula, or by using T. Smith's india-rubber valve, or Gresswell's tracheotomy tube, the free extremity of which is perforated with lateral holes, and is provided with a cap which can be screwed on so as to close the holes gradually more and more completely; as this is done the patient will breathe more through the glottis, and through a hole in the convex surface of the intra-tracheal portion of the tube. When, by any of these means, it is found that sufficient air can be inspired through the glottis, the tube may be removed. Bilton Pollard.

TRANSFUSION. — Various methods of transfusion have been proposed, and a vast amount of useless ingenuity exercised on the invention of machinery for its performance; but since the accurate knowledge of a single, safe and certain method, which can be applied on an emergency, is of more value to the practitioner than the names of a dozen different plans with complicated apparatus, one method only will be described.

The writer proposes, therefore, merely to give the method of transfusion of which he has had actual experience, having recently performed the operation on two occasions for the late Dr. Mahomed, in each of which there was not the slightest difficulty in transfusing from 30 to 40 drachms of blood. The method is simple and certain, if care

be taken to follow the directions laid down. The apparatus used is that of Aveling, slightly modified in its size and structure by the writer. The instrument must be made of the purest rubber. It is like a miniature Higginson's syringe, with the exception that it has no valves. It consists of an oval ball made to hold two drachms. At either end of the ball and directly continuous with it is an india-rubber tube 8 inches in length, having an internal diameter of a No. 4 catheter. Two silver canulæ $2\frac{1}{2}$ inches long, made conical in shape with rounded points, of the diameter of a No. 2 catheter at the apex, and of such a size at the base that the india-rubber tube will fit tightly over them, are provided.

The apparatus now consists of a simple tube with a dilatation in the centre, terminating in a canula at each extremity. This syringe, destitute of valves, is filled with a warm solution of salt and water. This filling is easily accomplished by squeezing the ball a dozen times or so in a bowl of salt solution. When filled, a bull-dog clip-forceps on the india-rubber tube, close to the canula, will prevent the escape of the water on transferring the syringe to position.

The arm of the giver of the blood is then compressed by three or four turns of a bandage high above the elbow. This makes the veins stand out prominently, and a suitable one about the bend of the elbow can be selected. The skin, being drawn a little to one side of the vein, is incised to the extent of $\frac{3}{4}$ of an inch, the incision going well into the subcutaneous tissue. On the skin being let fall back into its place, the vein shows clearly blue and distended in the incision. If it does not show clearly, it must be cleanly exposed by a little dissection of the surrounding subcutaneous tissue with the point of a director. The exposed vein is then temporarily covered over with a warm sponge, and the operator next exposes the vein in the arm of the recipient. This is not so easy, for, owing to the bloodless condition usually present, the veins are not so conspicuous. However, by pressure above them one of sufficient size can be selected. The exposing of the two veins completes the first stage of the operation.

The second stage consists in opening the veins, and in introducing the canulæ. A small table should be placed at the side of the bed, covered with a blanket. On this table the arm of both the giver and the recipient are laid, the giver being seated on a very low chair or stool. A portion of the vein of the receiver is now gently seized with a pair of forceps, and opened by dividing a part of the vein transversely just below the forceps. At the moment of doing this the little finger of the left hand, which is holding the forceps, should be pressed upon the vein, a little below the point at which it is opened. This controls the bleeding, and enables the operator to see exactly the little hole he has made in the vein. He is thus able to introduce the canula without difficulty. The hole made must be very small, so that, as the conical canula is passed up into the vein, it will fit tightly into the opening. The canula at the other end of the syringe is introduced in the opposite direction into the vein of the giver. An assistant is instructed to keep both canulæ in position with his hands.

The operator then proceeds to perform transfusion as follows. The clips having been removed from the tube at either end, the operator makes the necessary valve to prevent regurgitation by compressing with the finger and thumb of one hand the tube between the central ball and the giver. He then slowly squeezes the ball, with the effect of driving the water it contains gently into the vein of the recipient; then, having compressed the tube between the ball and the recipient, he removes the finger and thumb from off the tube on the opposite side, allowing the ball to expand with the blood coming into it from the arm of the giver. When the ball is full the manipulation just described is repeated, and the blood passes into the vein of the receiver. In this manner, each time the ball is compressed two drachms of blood are injected into the veins of the patient. Should the syringe appear to become blocked or work unsatisfactorily, it can be detached and washed out without removing the canula from the veins. Roussell's apparatus is strongly advocated by the inventor, but to those who have had experience of the two methods, there is no shadow of doubt that Aveling's apparatus is vastly superior. Roussell's plan is most unsurgical, and is merely an attempt to substitute the haphazard, blind puncture of a machine for the human fingers and eyesight, which alone are to be relied on in performing so delicate an operation as transfusion with ease, safety, and precision.

HARRISON CRIPPS.

TRAUMATIC ANEURISM. *See* ANEURISM.

TRAUMATIC FEVER.—The term traumatic fever has, up till the present

time, been vaguely employed to denote pyrexia of any kind following injuries of all sorts. Thus, it has been applied to all the kinds of pyrexia which commonly occur in surgical practice, and have therefore acquired the colloquial but misleading title of Surgical Fever. It is time that the term traumatic fever should be restricted to that class of cases in which pyrexia follows the infliction of a simple injury—i.e. one which, while causing a lesion of tissues, does not rupture the enveloping skin or mucous membrane, and, consequently, one which is not complicated by external septic influences, nor by the application of antiseptic substances to the wounded tissues. Even when the term is thus limited to such cases, we find that there are, clinically speaking, two conditions which each possess a distinctive form of pyrexia, and in which there is a difference in the detail of their causation. Thus, as a result of traumatism, we find that an injury involving fracture of a bone, with moderate rupture of the surrounding tissues, may under proper treatment be repaired without further adverse consequences; while another one, more violent perhaps, and possibly situated in the neighbourhood of large blood-vessels, will give rise to a series of changes, marked by congestion and œdema of the parts on the distal side of the injury. These two results of simple traumatism vary as much in the kind of pyrexia they produce as they do in their clinical features, and they will therefore be described as two distinct varieties of traumatic fever.

Symptomatology.—The general symptoms of traumatic fever, besides the pyrexia, are usually so slight as to escape notice in the large majority of cases, and, when they do occur, are practically summed up in those of headache and loss of appetite. These remarks apply rather to the first of the two varieties about to be described, since in the second the general symptoms are frequently prolonged and more severe.

The most important symptom, then, is the pyrexia, and this follows such a very definite course as to admit of the cases being grouped, clinically, into the two varieties. In the first variety, the temperature rises almost immediately after the single injury, reaching nearly its maximum within the first two hours, but gradually rising to that point during the first twenty-four hours. It then very slowly falls to normal in about a week. The intensity and duration of the pyrexia are both somewhat modified by the age of the patient, for, in individuals beyond middle age, the temperature rises to half the height it does in younger patients, and, moreover, lasts half as long.

In the second variety, instead of the temperature rising very suddenly nearly to its maximum, it rises rather more gradually (but still within five hours) to about half its ultimate height, and from this point it steadily rises for forty-eight hours, when it reaches its maximum. From this highest point, which averages 101° F., it falls till about the 120th hour after the accident, when it rises again to about 100°, and then falls to normal in three or four days. The second rise, just described, is peculiar to this class of cases, and the pyrexia is frequently continued for nearly a fortnight. Clinically, this variation in the pyrexia is accompanied by a very noteworthy difference in the condition of the limb. In the first variety, the limb is scarcely, if at all, swollen, and there is very little ecchymosis; but, in this second class there begins, soon after the accident, a gradual swelling of the limb, which reaches its height with the temperature, and, as noted above, the patient suffers from greater constitutional disturbance.

Pathology.—In both of the varieties of traumatic fever, just described, there is, in the very large majority of cases, one constant factor in the production of pyrexia, and that is, the fracture of a large bone, with the necessary accompaniment of some extravasation of blood and rupture of soft tissues. While admitting that the rupture of such important tissues as bone and muscle is nearly the determining factor in the production of the traumatic fever described as the first variety, it must be evident that, in the second class, we have a further effect on temperature superposed on that just described—an effect which is just as clearly due to the tension of the œdema of the parts around and below the fracture. In both varieties, then, we have pyrexia and the other symptoms of fever produced by a simple injury, and this, consequently, alone deserves the name 'traumatic.' In the present state of knowledge concerning the causation of fever (*see* Surgical Fever) in general, it is impossible here to do more than point out how much peripheral irritation of nerve-trunks there must be in the seat of a fracture, &c.

Prognosis.—Traumatic fever of itself is quite harmless, and never leaves any injurious sequelæ.

Treatment.—The treatment of traumatic fever is perhaps the least important,

if not the least interesting, side of the subject, for the whole treatment of a case resolves itself into preventing œdema and inflammatory changes at the seat of injury.

Nothing has been said above, purposely, concerning the delirium which sometimes occurs in cases of traumatic fever, for the reason that it can nearly always be traced to alcoholism, fat-embolism, &c., so as to leave pure traumatic delirium a matter requiring further investigation.

VICTOR HORSLEY.

TRENDELENBURG'S TRACHEA-TAMPON is an instrument which was devised to prevent the trickling of blood into the windpipe in operations about the jaws, palate, and pharynx, and also to facilitate the administration of the anæsthetic during such operations. It consists of a tracheotomy tube, which is surrounded by a hollow elastic collar at the part of the tube lying in the trachea; by means of a small syringe, this collar can be inflated and distended. When employing this instrument, the trachea should be opened in the usual manner and the tube introduced; the further administration of the anæsthetic should be carried on through the tube. Just before the operation is begun, the india-rubber collar should be inflated sufficiently to ensure its plugging the trachea completely. By means of this tube and tampon the gravitation of blood into the bronchi is prevented, and the anæsthetic can be given without in any way incommoding the operator. After the completion of the operation the tube may be removed, and, if necessary, an ordinary tracheotomy tube may be substituted for it. It is found in practice, however, that the inflation of the india-rubber collar is apt to produce irritation of the trachea and troublesome cough, and that a more satisfactory result can be attained by using an ordinary tracheotomy tube, and plugging the upper aperture of the larynx with a sponge, to which a string should be attached for safety.

BILTON POLLARD.

TREPHINING. *See* SKULL, Fracture of the.

TRICHIASIS—Inversion of the Eyelashes. *See* EYELIDS, Diseases of the.

TRICHINOSIS. *See* MUSCLES, Affections of.

TRICHOPHYTON TONSURANS. *See* TINEA TONSURANS.

TRICHOREXIS NODOSA. *See* HAIR, Diseases of the.

TRISMUS NASCENTIUM. *See* TETANUS.

TROCARS are instruments used for puncturing and evacuating the contents of cavities; they are usually provided with canulæ or hollow ensheathing tubes, through which the contents of the cavities may be drained away when the trocar has been removed. The above description refers to the trocars in common use for tapping hydroceles of the tunica vaginalis, or for tapping the bladder through the rectum. The trocar is solid and spear-pointed, so that it makes a triangular and slightly contused wound, which, if small, heals readily enough, though, if large, it may not do so. To meet this objection, the large trocars which are used for puncturing ovarian cysts are made hollow, and have a sharp and bevelled extremity, so that the wound made is a semilunar cut, which will readily heal.

The older cyst-trocars were provided with a blunt ensheathing tube or canula, with a truncated end. After the cyst had been punctured, the canula was pushed on so as to guard the point of the cutting tube. More recently, the canula has been placed within the cutting tube, and its extremity has been made dome-shaped, and the sides just behind the extremity have been perforated with large holes. The advantage of the latter alteration is that, if the cyst-wall or a secondary cyst come in contact with the end of the instrument, it is not likely to obstruct all the apertures. Some trocars are provided with a cutting blade for a short distance behind the point, so that the deeper parts of the puncture may be enlarged, if it be desired. Others, again, are grooved on one side, so that the instruments may be used as directors as well as trocars. The following are some of the more common special trocars.

Spencer Wells's cyst-trocar is a hollow instrument with a pen-shaped cutting extremity and an outer ensheathing tube, which can be pushed on so as to guard the point. When the instrument is meant for tapping ovarian cysts, preparatory to their removal, it is provided with spring claws for seizing and holding the cyst-wall just beyond the punctured portion.

Fitch's cyst-trocar differs from the last in the puncturing sharp point of the trocar being on the outer tube instead of on the inner one, as in Sir Spencer Wells's original

instrument. Dr. Fitch has recently had the canula made dome-shaped, and perforated with large holes just behind the extremity.

Ponteau's trocar, for tapping the bladder *per rectum*, is a long, curved, sharp-pointed solid instrument carrying a simple canula, which is provided with a shield.

Cock's trocar, for the same purpose as the last, is composed of five pieces—a blunt pilot trocar, a sharp-pointed trocar, and three canulæ. The outside canula is first introduced into the rectum by means of the pilot trocar, and held firmly in position; the pilot is next withdrawn, and the sharp trocar substituted for it; the base of the bladder is then pierced in a direction towards the umbilicus and the trocar removed, leaving the canula in position. A second tube with an expanding extremity, adapted to retain the canula in position, is next introduced, and within the second tube a third is placed in order to keep the second in its place.

Pearse's trocar, for suprapubic puncture of the bladder, consists of a trocar and canula suitably curved for the purpose, and of a catheter which fits the canula accurately and extends a little beyond it; the outer end of the catheter turns downwards at a right angle, in order to convey the urine away through an india-rubber tube.

Harrison's trocar, for tapping the bladder from the perineum through an hypertrophied prostate, consists of a hollow straight trocar, through which the urine flows as soon as the point has penetrated about half an inch into the bladder. The canula is provided with a movable shield, which can be fixed in any position so as to suit the size of the prostate and the depth of the perineum; there is also an inner canula with a blunt expanding extremity, which prevents the instrument slipping out of the bladder.

Southey's trocars are fine instruments, provided with canulæ which are scarcely larger than the needle of a hypodermic syringe; the canulæ are perforated with four holes on each side, and their outer ends are made a little bulbous, in order to retain pieces of capillary india-rubber tubing through which the fluid removed may be drained away. The instruments are used for the gradual removal of ascitic fluid, and for draining away the serous effusion into the subcutaneous tissues, in unyielding cases of general dropsy.

The harpoon trocar, or *emporte-pièce*, is a hollow trocar with a spear-pointed end and an aperture just behind it, through which the harpoon may be projected and then withdrawn again within the tube. It is used to remove pieces of muscle in suspected cases of trichina disease, or in other cases where a little of the tissue is desired for microscopic examination.

Bilton Pollard.

TRUSSES are appliances of various forms and of divers materials, which serve, in the case of reducible herniæ, to retain them within the abdominal cavity, and, in the case of irreducible herniæ, to prevent their increase and, ultimately, by pressure, to procure their complete reduction. A truss should exert an amount of pressure a little in excess of that required to retain completely the hernia, under all conditions and in all positions of the body.

Trusses are composed of different materials: elastic, as steel or vulcanite; inelastic, as leather, calico, or jean. Those formed of inelastic materials are not reliable, as they fail to exert a sufficient amount of pressure to keep the protrusion retained in any variety of posture; they are, however, occasionally serviceable in cases of large irreducible inguinal and umbilical herniæ. Those composed either of steel or vulcanite are alone capable of exerting the requisite amount of persistent, uniform, and pliant pressure.

Trusses should possess the qualities of lightness, pliancy, and adequate firmness; and these are best fulfilled by steel, which, after being pared from the sheet, should be carefully forged so as to render it more tough and ductile. The hammering of the steel at a blood-red heat, moreover, enables the artisan to give the truss the necessary thinning and tapering of the end opposite to the pad. Subsequently, the steel must be hardened and tempered. It is only by these means that the truss can be accurately adapted to the body of the wearer, clasping it at all points; firmly on the side of the hernia as far as the base of the sacrum, thence gradually lessening as it curves round the opposite iliac bone.

The basis of the truss is a narrow oval band of hardened and well-tempered steel, to the thicker end of which (in the case of a single truss) is firmly rivetted a slightly concave oblong head, which should not exceed two and a half inches in length, and an inch and three-quarters in its broadest diameter. The spring may be variously cranked so as to alter its pitch, thus allowing it to exert uniform and upward pressure according to the stoutness or thinness of the wearer. To the head is attached

a piece of cork, which forms the base of the pad, of the shape of a pear cut through, the narrow end being towards the shoulder. The pad, under ordinary circumstances, should be three and a half to four inches in length, an inch and a half to two inches and a half broad, and three-quarters of an inch in thickness. Over the inside of the spring and pad are laid three layers—one of glazed cotton and two of flannel; and, lastly, the whole is covered on the outside with calf and on the inside with chamois leather. To the outside of the steel head are affixed two studs, placed obliquely. To the upper one is attached the transverse cross strap; to the lower one, the under strap.

In the femoral form of truss the spring is weaker, the curve from the shoulder is more oblique, and the pad is smaller, and more hollowed on its outer side to prevent pressure on the femoral vein.

The under strap should always be worn, for it serves to maintain the truss in position, and prevents the pad from riding up during exercise. Air or water pads are sometimes substituted for cork, affording in some cases increased comfort to the wearer, but giving no additional security.

The form of truss best adapted for the large majority of herniæ is that known as the German serpent-spring truss, which more accurately than any other encircles the pelvis immediately below the crests of the ilia, affording at the same time gentle pressure when the body is at rest, and firm and increasing pressure when it is in action.

The truss, whether inguinal or femoral, should be adjusted high up behind, resting upon the base of the sacrum, immediately below the crests of the ilia; the pads terminating in front, in the inguinal form about one-sixth of an inch above the spine of the os pubis, and in the femoral form one-sixth of an inch to its outer side; the pressure of the pad being in the former case on the inner ring and the inguinal canal, and in the latter case on the femoral canal and the saphenous opening. The truss should be adjusted before the patient rises from bed, and be taken off after he has retired to rest. Irritation of the skin occasionally results from retention of perspiration, especially during hot weather; this is best obviated by washing the skin well every morning and, after careful drying, dusting it over with some powdered oxide of zinc.

The measurement for a truss, be it inguinal, femoral, or umbilical, should be taken in the following manner: A measured tape is to be drawn fairly tightly round the pelvis just below the crests of the ilia, and the two ends made to meet above the symphysis pubis, when the number in inches can be read off.

A truss should be applied as soon as the hernia is discovered, no age being too young for an instrument to be worn, even though the patient be only a few days old. The object of the truss is not only to retain the hernia within the abdomen, but, in a large number of cases—especially in those under ten years of age—to obtain a radical cure. The percentage of cures is necessarily difficult to ascertain, but, without doubt, the large majority of children do, sooner or later, become cured. When the frequency of hernia in early infancy is considered, and its comparative rareness in early adult life, as taken from the statistics of large educational establishments, it is fair to infer that the lesion has—temporarily, at any rate—been outgrown. In support of this it may be shown that in six years, at the City of London Truss Society, 6,268 boys up to the age of five years were supplied with trusses, while only 1,174 were relieved between the ages of eleven and fifteen years. In one large institution, containing over 800 boys, not one was the subject of hernia.

In infancy, the truss should be worn constantly, only being removed three or four times in the day for the sake of cleanliness. It is well to keep the parts well dried, and to absorb all moisture.

In adults, the truss may be taken off at night; but if there be any descent of the hernia, it should be kept constantly applied, and only removed night and morning for the purpose of washing. The truss should be adjusted when the patient is lying down, and care must be taken that the whole of the hernia is replaced before the truss is put on.

It is difficult to forecast the length of time required before a cure can be expected and the use of the truss discontinued; for the general deductions on this point the reader is referred to the article Hernia, Reducible.

In *inguinal hernia*, owing to the largeness of the rupture, the patency and approximation of the rings, and the difficulty of retention, it is often necessary to devise special instruments. Thus a hernia in the funicular portion of the tunica vaginalis is usually not kept up by an ordinary truss, and may require a rat-tail truss, which consists of a triangular prolongation of the soft part of the pad. A large, direct, inguinal hernia, again, can only be retained by a forked-tongue truss, to which, in addition to the rat-tail, is attached a soft transverse

portion crossing the pubes, and buckling to the shoulder of the opposite side.

In irreducible inguinal hernia a hinged-cup truss is usually needed, which not only supports the protrusion but, by its constant pressure, procures its reduction. This truss consists of a triangular rim-plate covered with chamois leather, attached by an oblique hinge to the lower part of an ordinary inguinal pad. If the hernia be a large entero-epiplocele, a suspensory bag of some strong inelastic material may be the only appliance which can be tolerated.

Besides these there have been many other trusses devised, and the ingenuity of the surgeon is often taxed to design proper and efficient trusses to meet the varying degrees of hernia.

In *femoral hernia*, if the ordinary truss does not answer its purpose, it is well to affix to the pad a thigh-belt with a triangular fulness to fit into Scarpa's triangle. In some large protrusions after herniotomy, it may be necessary to supplement the thigh-belt with an inguinal fulness to buckle to the shoulder of the opposite side. If the hernia be irreducible, which is very frequently the case, the pad should be more or less cupped so as to embrace the hernia, the cup being comparatively small, so as to afford persistent pressure.

Umbilical herniæ, a large percentage of which are irreducible, are best treated by a shallow, circular, concave plate, which not only compresses the hernia but, at the same time, supports the lower part of the abdomen. Nipple-shaped prolongations from the plate to fit into the umbilical aperture are unadvisable, as they tend by their wedge shape to gradually enlarge the opening. *See* Umbilical Hernia.

When the hernia is very large and irreducible, it often increases the patient's comfort to apply, first, a broad abdominal bandage, and over this to adjust the ordinary umbilical truss.

Although the circular spring truss, with its modifications, fulfils better than any form of truss all the requirements needed for the retention of herniæ generally, yet there are other forms which, under occasional conditions, supply important and practical advantages. Of these varieties the following are the more important :—

Salmon and Ody's truss consists of a semicircular spring, provided in front with an oval, slightly convex pad, which moves on a ball-and-socket joint, and having behind a circular flat pad to rest on the spine. It is adjusted round the pelvis *opposite to* the side of the hernia, and is usually worn without a cross strap or an under strap. It is especially useful in those classes of cases where the patients are thin and are therefore intolerant of the clasping pressure of ordinary trusses; it is also serviceable in incomplete and direct inguinal herniæ. The umbilical form of truss is often to be recommended in small umbilical and median ventral herniæ.

Coles's truss, like the preceding, has a semicircular spring with a circular pad behind, but to the front is affixed a pyriform convex pad, in the interior of which is concealed a broad spiral steel spring; so that, in addition to the general pressure of the spring, there is the local pressure of the spiral coil in the pad itself, which is increased as the truss is tightened. This form is useful in many cases of hernia, but chiefly in cases of direct inguinal herniæ, and of considerable bulging of the inguinal canal in incomplete hernia.

In *White's moc-main truss* the circular spring is superseded by a leather band. The pad is convex and thick, placed nearly vertically, and lying in a groove on its external surface is a spring and lever, on which is a stud. To this the under strap is attached, the tightening of which increases the pressure of the pad. This form of truss is chiefly of use in direct inguinal herniæ. It is comfortable to the patient, but is not very secure, as it fails to support the inner ring with firm and pliant pressure.

Wood's horse-shoe truss claims the merit of affording support to the canal and the pillars of the outer abdominal ring, without pressure upon the cord as it emerges between its pillars. The front pad, of horse-shoe shape, is made of boxwood, to the geometric centre of which is fixed the front end of the spring. A variety of this truss is provided with a spring and lever, and is stated to be useful in herniæ which are not retained by the simpler form of instrument.

Circular spring trusses are, by some instrument-makers, provided with sliding and with revolving pads, so as to be capable of adjustment to the various lengths and positions of the inguinal and femoral canals in different patients. The efficiency of these forms of trusses is, as a rule, in inverse ratio to the complexity of their mechanical arrangements.

These varieties, which represent the chief mechanical principles on which trusses are constructed, have undergone various modifications with the view either of increasing their efficiency or of lessening their discomfort to the wearers. They are so

numerous, that there are few towns of large size in England which have not given their names to one or other modification of the foregoing varieties of trusses.

JOHN LANGTON.

TUBERCLE has of late been classed among the 'infective granulomata,' a group which also includes syphilis (gumma), lupus, glanders (farcy-buds), leprosy, and actinomycosis, but the degree of its infective force, not yet distinctly formulated, is at all events greatly inferior to that of the other diseases placed in the same class.

Histology.—A tubercle is a non-vascular rounded nodule situated among vascular tissues, from which it generally so varies in colour as to present a clearly definite outline, and varying in size from a barely perceptible point to a lump half an inch or three-quarters of an inch in diameter. It appears under two forms. Miliary or grey tubercles, often also called grey granulatious, frequently multiple, rarely exceeding the size of a pin's head, are pearly, semi-translucent globules. The yellow or crude tubercle is produced from the former by a process of fatty degeneration commencing in the centre, while peripheral growth still continuing permits this form to attain the dimensions above mentioned. Larger masses, usually of more irregular form, are due to the coalescence of several smaller ones.

Examined under a power of 200–300, the grey tubercle is found to consist of three zones of cells, supported by a delicate reticulum. The periphery, which is without any definite outside or inside limit, consists of leucocytes or lymphoid elements. These are occasionally supported by a homogeneous or obscurely fibrillated network. Next, is a layer of large pellucid cells of the epithelioid type. The third zone consists of giant-cells usually branched; it is said that these branches are continuous with a fine reticulum, which permeates and supports the cells of the second zone. In some instances, the immediate centre is occupied by an irregularly granulated material, probably the débris of one or more deceased giant-cells. In all this there is, be it observed, no distinctive or specific element; but since the year 1865, when Villemin, followed by Wilson Fox, Cohnheim, Sanderson, and others, produced artificial tuberculosis by inoculation, the possibly infective nature of the disease in the human subject has been suspected. After Pasteur's description of septic and of certain pathogenic micro-organisms, many attempts were made to discover a like generator of tubercle, but all more or less unsuccessfully until, in 1882, Koch, by using a specially prepared solution of methylene-blue, was enabled to demonstrate the existence, within the giant-cells, of a living organism which he calls *bacillus tuberculosis*. This organism is a rod, generally straight, but sometimes slightly curved, $\frac{1}{7000}$th of a line (2–6 mm.) long, and in breadth one-fifth or one-sixth of its length —i.e. about $\frac{1}{40000}$th of a line broad. Its chief habitat is the interior of the giant-cells and the interspaces among the large epithelioid cells of the second zone of tubercles; its movements, if any, are extremely sluggish.

Course and Termination.—Very occasionally, tubercle undergoes a change into an imperfect fibroid tissue, due apparently to an exaggeration of the reticulum; and though, even when thus altered, it generally suffers fatty degeneration, it does sometimes remain as a hard cicatrix-like nodule. Also, in a few instances calcification takes place. But the course of tubercle, so usual as almost to deserve the term normal, is caseation and softening. The latter is commonly called 'breaking down.' When a grey granulation has attained a certain size, the older central parts, which are those farthest removed from nutritive sources, begin to soften into a fatty, irregularly granulated material, which imparts to the hitherto pearly grey nodule a yellowish opaque colour (yellow or crude tubercle). Sometimes, this is preceded or closely accompanied throughout the nodule by caseation; or, after the central parts have thus broken down, the more peripheral portions may become caseous, previous to yielding to the more completely destructive process. The resulting mass is a fatty pultaceous semi-solid.

As these degenerative processes approach or reach the outer zone of the growth, so does the neighbouring tissue inflame. Thus, the healthy or relatively healthy surface next to the mass of disease suppurates, and there is an attempt to throw off the tubercle into a tube or hollow viscus if it have been on a surface, or into a cavity of new-formation if it have been parenchymatous. In the former case a tuberculous ulcer, in the latter a tuberculous abscess or *vomica* results, the floor or the lining membrane of which might be (in a few rare instances is) healthy, but that the softened or caseated tubercle has a great tendency to infiltrate the immediate neighbourhood, or to induce round about

the deposit of fresh tubercular matter, in the form of miliary tubercle, scattered in the tissue surrounding cavities or ulcers of considerable age. Thus, the floor or walls of such excavations very generally consist, in part, of rapidly forming and quickly retrograding tubercular matter, which, continually invading more and more tissue at the circumference and breaking down at the centre, constantly enlarges both the area of tuberculous deposit and of ulcer or abscess. The gravity or the deadly nature of such processes depends chiefly on the locality of its occurrence; but not altogether so, for, when tubercle has gained a habitat in some part of the body, it has a tendency to spread to other portions by means of the lymphatics or the veins, which may carry some of the *materies morbi* from less to more important parts.

Clinically, tuberculosis is divided into acute and chronic; the former is often widely spread—that is, a number of different organs become simultaneously or in very rapid succession infested with tubercles, which, if the patient survive long enough, quickly break down.

Acute general tuberculosis, or tubercles, may attack with almost equal rapidity one organ only, or at least so predominantly that the affection of any other viscus is quite secondary, both in sequence and importance—*acute pulmonary* or *acute hepatic*, or otherwise specified *tuberculosis*.

Occasionally an organ, unessential to life, may be suffering for months from chronic or subacute tuberculosis, when some more important part, as, for instance, the lungs, the cerebral meninges, or the brain itself, may become rapidly involved, death very quickly resulting—*acute secondary invasion or infection of tubercle*.

Local tuberculosis is, as a general rule, chronic. It may affect internal organs, as the lung, liver, brain, kidneys, or it may attack the lymphatic glands primarily, skin (lupus), Peyer's and the solitary intestinal glands, the tonsils, the adenoid tissues at the back of the pharynx, the bladder, prostate, and ureters; also, as is generally believed, the synovial membranes of joints and the bones. (On the tuberculosis of these two latter more will be said in the sequel.) The ovaries, the mammæ, the thyroid, and the muscles (voluntary), are singularly, but not entirely, exempt. Wherever it may arise, tubercle goes through the phases above described, unless its mere presence in some organ of great vital importance excite fatal irritation or inflammation.

Etiology.—The course of tuberculosis, especially as exemplified in phthisis, gave rise many years ago to the opinion that it was in many instances of an infective character. The discovery by Koch of the bacillus tuberculosis, which, after eight generations of pure cultivation, diffused in distilled water and injected into animal tissues, can produce both local and general tuberculosis, has rendered that opinion still more prevalent; while more recent experiments, carried out with all the precautions now known to be necessary, have negatived former results, which seemed to show that indifferent substances, such as glass-beads, setons, &c., introduced into, and left a certain time within the body, resulted in the production of tubercles. Furthermore, animals made to inhale tubercular matter diffused in their atmosphere as spray, develop tubercle, chiefly of the lung. So stringent do these facts appear to many minds, that they consider inevitable the conclusion that tubercle is due to infection by bacillus tuberculosis, and that it can arise in no other way. As, however, in the human subject, entrance of tubercle by inoculation or infection through the skin is unknown, it is by such believers assumed that the tubercle bacillus always finds its entry in man by way of the lungs or of the alimentary canal; in the former case by breathing the same air as phthisical patients, in the latter by eating meat infected by the very common bovine tuberculosis. They point out that such bacillus, if it survive, need not of necessity find its ultimate lodgment at the point it first strikes, but that, taken up by the blood or lymph, it may pass with either circulation to the next most vulnerable point, such as a lymphatic gland, a serous membrane, or some not quite healthy viscus. They furthermore affirm that everyone exposed to the above sources of infection does not of necessity become tuberculous, because the bacillus seems incapable, or capable only with extreme difficulty, of thriving on or in healthy tissues, but that the soil must be to a certain extent prepared by some morbid condition, the chief of which is a low or chronic inflammation, or perhaps that state of ill-nutrition of the tissues which forms the definition of scrofula. *See* Scrofula.

But it must also be stated that many pathologists hesitate to accept this theory, being perhaps put somewhat on their guard by its very ease and apparent simplicity, as well as by the fashion of the hour to find bacilli in so many morbid processes. They point to the fact that the diseases known to

be connected with the development of living germs, such as pyæmia, splenic fever, &c., run a course much more acute, and in other ways differing from local tuberculosis; that most tubercles, in parts having no access to the outward air, show a great paucity of bacilli, and in many those organisms are not discoverable at all; that there is much difficulty in accounting for the existence of a bacillus in healthy animal fluids while travelling from the first spot of implantation to, let us say, the cerebral meninges; that the acknowledged necessity for some antecedent morbid process to prepare a *locus vivendi* for the bacillus, into which, by means of such navigation, it may find its way, is not easy to accept; also, that many facts of heredity are not reconcilable with the dogma that tuberculosis can only be produced by reception, from without, of a *contagium vivum*.

The writer thinks it best to place these arguments on either side in juxtaposition, without himself offering any opinion, but, nevertheless, must say a few words on a prevalent tendency to confuse scrofulous with tuberculous inflammation. The two things are distinct. Irritation of teething or of a slight scalp-eruption may produce a lymphadenitis of the neck, which, lasting a long time, becomes evidently scrofulous, but which may subside, or which may become the site of tubercle, but is not, until so infected, tuberculous. So also a joint or a bone may, after some slight injury, assume a scrofulous inflammation. The tissues are rendered no doubt fit for, but may never receive, tubercle, and until they do so the inflammation is strumous, not tuberculous. When they do so the condition is tubercle, not of a bone or of a synovial membrane, but of an inflammatory product. The nodules, named by Rindfleisch 'new lymphatic follicles' (*see* Scrofula), have often been mistaken for tubercles. When either the grey granulation or the tubercle bacillus has been found in such a tissue, still nearly healthy or only very recently diseased, and not until then, will primary tuberculosis of those parts be established.

The *treatment* of tubercle depends in very great part on its situation. Tubercle of the viscera in the three great cavities belongs to the physician. Tubercle of the throat, lymphatic glands, of the prostate and bladder, is described under their respective headings. General directions for treatment can include little but management of a diathesis, and is identical, or nearly so, with that of scrofula, save that residence in sufficiently warm, dry, and above all, equable climates, is of the highest value. High altitudes are also greatly advocated, and next in efficacy is sea air. Whatever may be believed concerning the bacillus tuberculosis, there is, at all events, sufficient probability in the hypothesis and the alleged discovery, to render imperative that we carefully avoid exposing predisposed persons to the emanations of phthisis or of other tubercular diseases. We may even go further, and sequestrate such individuals—especially if for family reasons the life be valuable—from any prolonged contact with tuberculous persons.

The possible spread of tubercle from some less important part to a vital organ calls forth the question of early removal, when feasible, of all tuberculous parts. The subject is too recent to be discussed; it can only be suggested here as a surgical problem of the immediate future.

Richard Barwell.

TUBERCULOSIS, Surgical. — Local surgical disease, characterised pathologically by the presence of tubercle in any of its forms, the clinical course of which coincides with the morbid changes known to occur in tubercular deposits.

The subjects of scrofula and tubercle have been treated of under their respective headings; this article is intended to serve as a brief exposition of the views on local tuberculosis which the labours of German pathologists, especially Volkmann and König, have done so much to generalise. A lengthened general introduction to the local affections treated of below would therefore be superfluous, but it is necessary to make a few remarks on the connection of surgical tuberculosis with scrofula, the etiological importance of trauma and inflammation, and the relation of local to general tuberculosis.

Volkmann suggests that the tubercular nature of an affection is indubitable when (1) inoculation gives positive results, (2) the bacillus tuberculosis is demonstrable, and (3) the tissues exhibit the typical structure. These three confirmatory conditions are, however, not to be looked for in every case, since inoculation sometimes fails from accident, or incapacity for infection of the animal chosen; (2) the bacilli are in some cases, in chronic ones especially, very limited in number; and (3) in some acutely progressing cases the structure is not characteristic, although the bacilli may be abundant. Under these circumstances, two of the conditions should suffice, especial prominence being given to the inoculation test.

All recent investigations tend to support the infectious nature of tubercular processes, and, moreover, to strengthen the dependence of this property on the bacillus of Koch. Considering the wide distribution of the infecting organism, it is necessary to endeavour to gain some notion of the reason why some of those exposed to infection suffer from tubercular diseases while others go free. In the present state of knowledge, this is explicable only on the supposition that healthy vital tissue is an unfit nidus for the development of the virus. Some change must occur before the organism can develop itself, and induce the characteristic process and appearances due to its presence. The condition most favourable to this development is a local or general depression of the vital processes, leading to inflammatory changes, and it is here that the connecting link between scrofula and tubercle has been sought. The scrofulous diathesis has been said to consist in a tendency to processes, essentially of an inflammatory type, marked by the characteristics of chronicity, a tendency to the development of granulation-tissue and to caseation. Thus, under the head of scrofula are described characteristics both of a general diathesis and of local affections. Attempts have been made to explain the peculiarities of the inflammations occurring by special structural arrangements, which find mention in the article on Scrofula.

When we endeavour, however, to separate the local processes due to scrofula and tuberculosis respectively, we find ourselves landed amongst innumerable difficulties. Most pathologists will, no doubt, admit that the majority of such processes belong to the province of tubercle; indeed, in some organs —notably the testis—the name tubercular testis is rapidly superseding, if it has not already altogether done so, that of scrofulous testis. Again, in the case of so-called scrofulous glands, authors (Allbutt and Teale) who do not call them tubercular, allow their capacity to produce tubercular disease on inoculation. The writer thinks it will not be long before this change in terminology occurs in most other so-called scrofulous diseases. Are we then to regard scrofulous and tubercular diseases as identical? Here we are met by the difficulty, well put by Volkmann, that a healthy blooming individual may present all the general characteristics of the scrofulous diathesis, but no local affection as evidence of tubercle. It would seem best, then, to restrict the term scrofulous as indicating a diathesis characterised by the personal peculiarities described in the article on Scrofula, and, while not denying the possibility of simple inflammations in scrofulous subjects, to refer all those inflammations which have been described, as undergoing the changes already mentioned—changes ordinarily occurring in tubercle—to the category of tuberculosis.

Traumatism, as a causative agency, finds an explanation in the induction of a precedent inflammation. The slightness of the violence exerted, often noted, is perhaps of importance as not occasioning a very acute process, a condition unsuited to the development of the organism (Volkmann). Allied to trauma as a cause, is overuse of a part, as exampled in tubercular disease of a joint, freely used from its position and the occupation of the patient—e.g. elbow in a mason. The ultimate tubercular nature of many joint cases, commencing during the course of an acute exanthem, may perhaps be similarly explained; the inflammatory infiltration offering a suitable nidus or *locus minoris resistantiæ*.

Another point of extreme importance, from a prognostic point of view, is the possibility of these local affections acting as infecting centres for the production of a general tuberculosis. The mode by which the primary infection occurs, as far as our knowledge will allow us to presume, is commonly from the alimentary or respiratory tracts, possibly, in rare cases, from a broken cutaneous surface. A primary infection having taken place, the modes of extension or generalisation may be shortly enumerated, as a consideration of these gives some indications as to surgical treatment, and also explains the comparatively good prognosis in cases of external tuberculosis. They are—

1. By wide extension of the original deposit in the surrounding tissue, or direct extension along mucous or serous surfaces.

2. By extension through the lymphatic system, such extension being usually limited by the lymphatic glands. If the tuberculosis spread beyond these it may reach the thoracic duct (Ponfick), and so the virus may be poured directly into the general circulation. Volkmann remarks that the function of the lymphatic glands as stop-gates, or even possibly destroyers of the poison, has not yet been sufficiently recognised.

3. Infection of a serous sac, either by direct extension, or by rupture of a neighbouring suppurating or caseating deposit. The danger in the latter case depends on the size of the sac, its lymphatic connec-

tions, and possible lining with granulations,—forming a barrier against further diffusion.

4. The entrance of tubercular matter into canals or cavities lined with mucous membrane, where stagnation is possible or actual length renders long contact inevitable.

5. Entrance of tubercular matter into veins by extension, or rupture of neighbouring deposits (Weigert); or by septic changes in tubercular wounds, leading to breaking down and distribution of the venous thrombi (König).

Consideration of these modes of extension explains the comparatively favourable position of a patient suffering from tuberculosis of the skin, bones, joints, or glands; for, in addition to the fact that the affected organs are less important in the vital economy, the danger of generalisation from them is manifestly less than in tuberculosis of the respiratory, alimentary, or genito-urinary tracts. As to the frequency with which general or secondary infection occurs, it is difficult to speak with certainty; but in relation to this subject, a point much insisted on by Volkmann is of great importance—viz. that in many cases the primary deposits are multiple, although only one causes appreciable symptoms. A familiar instance in support of this is the multiple nature of the lesions in tubercular dactylitis. That a large number of cases die of tubercular phthisis was long ago pointed out by Billroth, and has since been confirmed by many authorities, but it is not possible to give any reliable percentage of cases in which the pulmonary disease was evidently secondary. A certain number of cases, particularly of tuberculosis of joints, die of acute general tuberculosis; but here a point emphasized by König must be regarded with attention—namely, that in all the instances in which this occurred among his cases, the patient had been recently operated on, and the wound had become septic. The writer has seen similar cases. These considerations, therefore, would seem opposed to the theory of removing a local infecting centre as a general rule, except in such a case as the testis, where removal may prevent direct extension, by continuity of surface, through so important a tract as the genito-urinary.

As has been already pointed out, the danger of general infection is not great, and when the disease is limited to external parts, the interference with the vital functions is not sufficient to make the outlook a correspondingly bad one to that in cases where internal organs are affected. The local prognosis is of more importance; and here it may be broadly stated that complete removal ensures local cure, but the possible presence of other deposits may prevent the cure from being complete. A number of secondary considerations will affect the question—as the surroundings of the patient, the extent of the disease, and the general condition; the nature of the process as to its tendency to granulation, caseation, or suppuration; the age—youth, as in other diseases, being on the patient's side, and markedly so both in the possibility of spontaneous cure, less rapid destruction, and in the relative infrequency of concomitant pulmonary phthisis. Lastly, as to spontaneous cure: under favourable circumstances this is always possible, but, as in all other diseases of a similar nature, recurrences may readily take place from fresh activity of the process in and around the latent deposit.

Tubercular Disease of Bone.—The deposit of tubercle in bone may form a part of an acute general miliary tuberculosis, or it may be a distinct local affection. In the latter case it may of course serve as an infecting centre, but more commonly its prejudicial consequences are the result of direct extension.

Miliary tuberculosis of bone, as a part of an acute general condition, may be dismissed with mere mention, since it is uncommon and devoid of clinical interest. Recognition of the frequency of local tuberculosis amongst chronic bone-affections is, however, perhaps the most important result of recent investigation of tubercle from a surgical standpoint. The disease is characterised by definite appearances, situation, and course of extension, which allow a fixed boundary to be placed between it and other forms of bone-affection, such as acute infectious osteomyelitis, simple chronic inflammations, or those due to syphilis. Subsequent description will, however, identify the affection more or less completely with that often spoken of as scrofulous.

Situation.—No bones or parts of bones are exempt from the possibility of tubercular disease, but the special seat of predilection is the cancellous structure of the articular ends of the long bones and of the short bones. Deposits are common in the bodies of the vertebræ, the os calcis, the olecranon, the condyles of the humerus, and the neck and internal condyle of the femur. Observation tends to free the head of the tibia from the unenviable distinction of being the head-quarters of this disease. The shafts of the long bones and the flat

bones may be affected, the most typical examples of the former occurrence being met with in tubercular dactylitis; while deposits are common in the acetabulum, and far from rare in the glenoid cavity of the scapula and the skull.

Appearances. — The morbid processes vary according to the structure of the bone affected, and will be considered here first as they are met with in cancellous, then in compact bone.

Localised Tubercular Ostitis.—In cancellous bone the disease commences as an ostitis affecting limited areas, which may vary in extent from the dimensions of a pea to that of a hazel-nut. The deposits may be single or multiple; in the latter case two or more may coalesce by extension. The process is primarily rarefying in character, the bony trabeculæ being thinned by absorption of the walls of the Haversian canals, soft granulation-tissue, containing histologically perfect reticular tubercle, taking the place of the harder element. The ultimate termination may vary considerably: the bone-tissue may be converted into a mass of granulations without suppuration (caries sicca); the process may proceed irregularly, small islets of bone being cut off and necrosing (caries necrotica); a sequestrum of some size may be formed, or caseation or suppuration may occur. In the case of the caries assuming the dry form, secondary ossification and sclerosis may occur; if caseation or suppuration supervene, the area may become encapsuled by a layer of sclerosed bone.

In the majority of cases progressive changes occur, the tendency being to extend peripherally—in the joint ends preferably towards the articular cavity—the cartilage being undermined and perforated by the granulations. Perforation may, however, take place beyond the articular margin, in rare and favourable cases even beyond the attachment of the joint-capsule. The two latter occurrences are the less frequent, from the fact that extension towards the compact tissue is usually accompanied by subperiosteal bone-formation, which renders perforation a slower and more difficult process. They are of radical importance with regard to the possible implication of the joint, and the limited or diffuse nature of the local joint-affection. This subperiosteal bone-formation accounts for the actual enlargement of the bone-ends occasionally met with. Prior to perforation, and even when that has occurred, a satisfactory view of the affected area can only be obtained by section of the bone-end. The appearance will then vary according to the special form the process has assumed.

Circular defects or burrowing tracks may be met with, either single or multiple; in the case of dry caries, often the latter; these may be situated near the centre or peripherally. In recent cases they may consist of soft grey or reddish-grey granulation-tissue, often with evident tubercles at the periphery, and surrounded by an area of hyperæmic bone. If caseation has occurred, the tint will be yellower, and, when the granulations have been cleared out, in recent cases the walls will be softened, in old cases more or less sclerosed. In all cases, molecules of bone exist in the granulations; in caries necrotica, palpable sequestra are present; in other instances, the whole of the centre of the area originally affected forms a sequestrum permeated with tubercular granulations, and lying in a cavity lined with similar tissue more or less firmly connected thereby to the sclerosed wall or surrounding bone. In other cases the cavity will contain broken-down caseous material and pus. If the process has extended directly down to the cartilage, the latter will be more or less extensively detached, perhaps perforated; if perforation has occurred beyond an articular margin, more or less irregular disposed periosteal bone will surround it. In rare cases, the bone may be secondarily affected by extension of the tubercular process from the soft parts, as seen in cases of lupus of the face extending down to the bones. Where the affection of the bone is recent, tubercles may be found deposited in the marrow of the cancelli, without any change in the trabeculæ (Volkmann).

Besides the forms of necrosis already adverted to, a third occurs. Here, a considerable area necroses as a result of a somewhat more acute tubercular infiltration. This may occur in the pelvis, ribs, skull, or notably in the articular ends. When met with in the articular ends, the sequestra are often of a typical wedge shape (suggesting to König a possible embolic origin, the whole area becoming infected by bacilli spreading from the original embolus into the arterioles), of a yellow colour, permeated by tubercular granulations, and separated from the surrounding healthy bone by a layer of tubercular granulations to which they are attached, and which preserve the bone from wider affection. In the skull and pelvis they are irregular in outline; in the case of the former, the sequestra are

similar in character, but are peculiar in affecting both tables of the skull to an equal extent.

Diffuse Tubercular Osteomyelitis.— This is a much less common and more serious disease than that above described. The tubercular infiltration may affect the whole medullary cavity. It usually commences at a cancellous end, but, deviating from the common course, extends centrally. The medullary cavity becomes filled with soft, breaking-down, tubercular granulations; the compact tissue is much thinned. Local prognosis in these cases is very bad.

Tuberculosis of the Shafts of the Long Bones.— This affection, implicating the compact tissue from the first, is less common than the form first described. The disease is commonest in the metacarpal and metatarsal bones and their phalanges; more rarely it occurs in the femur and tibia. It is a disease of childhood, characterised by chronic enlargement of the bones, due to the following process. Deposition of tubercle takes place both in the medullary cavity and periosteum; this leads to the development of granulation-tissue in the canal, and of irregular spongy nodes containing tubercle beneath the periosteum. The true compact tissue is gradually thinned, while, later, a layer of hard bone is sometimes developed beneath the periosteum on the surface of the osteophytic nodes. The process sometimes subsides spontaneously, and subsequent absorption of the new bone removes all trace of its occurrence; more commonly, however, considerable shortening remains from arrest of growth.

Effects of Bone-Tuberculosis.— The extreme importance of the process is derived from the formidable nature of the complications due to extension. Here we find the origin of an overwhelming percentage of the cases of joint-tuberculosis; while bones bordering on the large cavities may, when so affected, lead, by extension of the process, to meningitis, pleurisy, or peritonitis, with all the attendant dangers of infecting a large lymphatic sac. No more fertile source exists of cold abscesses, especially in their most formidable form—the spinal abscesses; and, lastly, no disease of bone so commonly leads to lasting deformity from loss of substance, as is met with in spinal caries and pathological displacements of joints.

Signs of Tubercular Disease of Bone. These are chronic in nature, often most insidious; in many cases the first sign met with is due to some complication. An important early symptom is pain, which may be characterised by the deep boring character and nocturnal exacerbation common in central bone-cases, but this may be absent. Later, local thickening and tenderness, followed by œdema, redness, and suppuration, may occur; the suppuration may sometimes be superficial, but is generally in direct communication with the osseous deposit. When the suppuration has pointed, a chronic fistula is usually established, lined with tubercular granulations, discharging thin unhealthy pus. On probing, the sensation will vary with the form of caries present; the commonest result is to feel the bone covered with granulations, and often small sequestra, giving a gritty feeling, may be embedded in these. Such fistulæ are extremely chronic, and rarely heal without treatment.

In many cases, however, where the joint-ends are affected, joint-symptoms, as local tenderness or pain on some particular movement, with more or less effusion, are often the first signs; such synovitis at an early stage is often simple, thus differing widely from that met with when perforation has occurred, and when a well-marked joint-tuberculosis is the result. In disease of the vertebral bodies, neuralgic pain, deformity, or abscess may be the first sign, and abscess or neuralgia may be the first signs of pelvic disease. Tubercular necrosis of the vault of the skull is most common in the frontal and parietal bones; it may be heralded by cerebral symptoms from pressure due to inflammatory effusion within the skull; in other cases a large, lax, cold abscess forms. Necrosis of a rib, again, is often first evidenced by abscess or empyema. In the case of the long bones, increased epiphysial growth may result from the abnormal vascularity, or, later, dislocations may occur from actual loss of substance.

In tubercular dactylitis, a chronic fusiform enlargement of a metacarpal or metatarsal bone or phalanx may take place, often without pain. Several bones are often implicated. The disease may, after a time, recede, leaving slight evidence of its occurrence, but, usually, arrest of growth leaves permanent shortening in cases of recovery. If it progress, the skin and surrounding tendon-sheaths become implicated, reddening occurs and suppuration; the disease often leads to spontaneous fracture. A marked characteristic is the limitation of the disease to the diaphysis. Its occurrence is limited to childhood.

Diagnosis.—The presence of tubercle in other organs, a tubercular history, or the special personal characters are often of value. The less acute nature of the process, and its tendency to spread in the direction of the epiphysis (dactylitis excepted), contrast strongly with the extremely acute invasion and tendency to spread in the diaphysis, characterising acute osteomyelitis. In the later stages, the different character of the sequestrum, its yellow colour and permeation with granulations, contrast quite as markedly with the hard white sequestrum of osteomyelitis. In the case of more chronic simple ostitis or caries the diagnosis is more difficult, and must depend on the general aspects of the case and a microscopical examination. The history, and the result of treatment, should settle the question of syphilis in any given case; but difficulty may arise in some cases of dactylitis and necrosis—in the latter, the tendency to sclerosis in syphilitic affections should be borne in mind.

Prognosis.—This depends greatly on the situation of the disease, and the direction in which extension may have taken place, greatly also on the dry or suppurating character of the original deposit, which will impress a corresponding character on any further processes it may give rise to by extension. Local cure may follow complete removal, or may occur spontaneously; in the latter case, usually leaving some permanent deformity (angular curvature, shortening, &c.). In no case, however, where spontaneous cure is supposed to have occurred, is the patient free from danger of subsequent recurrence from the lighting up of a fresh inflammation at the latent spot.

Treatment. — The general treatment differs in no way from that followed in other cases of tuberculosis. As to local treatment, the first indication is rest, and, where extremely chronic symptoms exist, counter-irritation may be of use. The first indication is usually fulfilled by the use of splints; for the second, blisters or, rarely, the actual cautery may be applied.

When signs of progressive disease exist in the neighbourhood of a joint, no time should be lost in trephining or chiselling the bone, so as to afford a free exit, and divert the course of extension from the direction of the joint. Any cavity thus opened should be freely scraped out with a sharp spoon, or the wall chiselled away, and the cavity may be dressed with iodoform. Where a sequestrum exists it should be removed, and the walls of the cavity treated in like manner. The question of excision and amputation are treated of in the next section on joints.

Tubercular Disease of Joints.—These affections are broadly divided into two classes: 1. Where articular disease is secondary to tubercular ostitis of the joint-ends. 2. Where primary tuberculosis of the synovial membrane occurs.

1. *Arthritis secondary to Tubercular Ostitis.*—This may depend on extension of any of the forms of bone-disease above described, the nature of the primary process impressing itself on the secondary joint-mischief. If the primary disease is of the dry or fungous form, or if one of the wedge-shaped sequestra is present, suppuration does not necessarily occur; if, on the other hand, caseation or suppuration of the primary deposit has taken place, a local or general suppuration of the joint-cavity is the invariable consequence. The perforation leading to infection of the articular cavity may, as already mentioned, take place either through the articular cartilage or through the bone beyond its margin, but internal to the line of attachment of the ligaments. This point of infection is of considerable importance, since, if it be beyond the margin of the articular cartilage, inflammation of the periosteum and structures in immediate contact with it may have led to adhesions, so disposed as to ensure the general joint-cavity from infection. If, on the other hand, the perforation be subchondral, a general infection of the articular cavity is the result. The possibility of such a local infection must always be taken into consideration in examining the tissues for tubercle, for it may exist here alone and in very limited extent, although considerable inflammatory change may have occurred in the synovial membrane generally. The bone-deposits may be single or multiple, confined to one bone, or affecting both bones entering into articulation. The appearance of these deposits has been already described under the heading of *Tubercle in Bone*; it will be only necessary to describe here the condition of the remaining joint-structures.

The cartilages are always secondarily affected, playing a passive part. In cases where perforation is subchondral an opening may exist, the edges of which are bevelled off from the osseous aspect to a thin margin, or the whole sheet of cartilage may be separated, hanging in shreds, or readily tearing off the subjacent granulations. When perforation has occurred beyond the margin of the cartilage, the latter may still be loosened, as the result

of a subarticular ostitis or caries; in other cases it is absorbed from its free surface by the granulating synovial membrane. In the latter case, it may retain its attachment until total absorption occurs by a process of gradual thinning. In examining the subchondral osseous granulations in such cases, especially the latter variety, it will be found that they are very frequently simple in nature, the tubercular process being limited to the original deposit and the immediate neighbourhood of its perforation.

The synovial membrane is thickened, in the more chronic cases enormously so, both by the development of a species of false membrane on its surface and by infiltration of its deeper layers; it is of a greyish or brownish-grey tint, studded thickly with lighter-coloured spots, softened and pulpy in consistence. On examination, it is found to contain enormous numbers of typical reticular tubercles and long areas or stretches of tubercular tissue, suggesting to König the idea of invasion of the lymphatic spaces; in addition, numerous isolated giant cells are met with, dispersed through the small-celled infiltration. In old cases, a similar infiltration may have invaded the ligaments, though for the most part the infiltration in these is of a simple inflammatory nature; this latter usually extends into the pararticular structures, binding down the skin and destroying its normal mobility. The subsequent contraction of this pararticular infiltration causes the white anæmic condition of skin which led to the adoption of the name of white swelling. The infiltration and softening of the ligaments allows the occurrence of spontaneous dislocation. The joint-cavity may be more or less obliterated or cut up into sections by adhesions, or it may contain a varying amount of thin cheesy pus. Such pus may come to the surface and point externally; in other cases, abscesses form in a localised cavity or on the external surface of the joint-capsule. These pararticular abscesses are usually the result of caseation and suppuration in the infiltration of the soft parts above described; in rare cases, they may result from the perforation of tubercular deposits in the articular ends, beyond the attachment of the ligaments.

In other cases where, as already mentioned, the process of infection has been limited by prior adhesions, the tubercular changes may be limited to a small area, while the other changes in the joint are of a simple nature; and, where the course is chronic, these may be entirely atrophic in character, so that, in place of the large fusiform pulpy joint, a thin skeleton-like joint may be present, the atrophy of the soft structures leading to the idea that the bone-ends are considerably enlarged. Actual localised enlargement may exist when periosteal new bone-formation has occurred. In old suppurating cases, again, a very considerable new bone-formation may exist, generally within the joint-capsule. The muscles of the limbs undergo fatty degeneration and atrophy from disuse; this may sometimes be masked by the existence of extensive tracts of suppuration in the deep planes of the limb. Pathological dislocations of the joints are common, either from shortening and malformation due to absorption; from separation of portions of bone, as in the case of the head of the femur where the neck is implicated or a part of the acetabulum is necrosed; or by the pushing out of the head of a bone from a joint-cavity by redundant granulations, as may occur in the case of the femur and acetabulum.

2. *Primary Synovial Tuberculosis.*—This may take on several forms; the affection of the synovial membrane may be local or general, and the tendency may be to serous or suppurative inflammation.

In its severest form, we have the most typical example of white swelling, and the appearances do not in any way differ from those described in the last section, except in the absence of osseous deposits, and the fact that the tuberculosis of the joint is usually general.

In the serous forms, less thickening of the synovial and subsynovial tissues occur, and the disease is characterised by considerable distension of the joint, the fluid being clear or containing flakes of lymph or melon-seed bodies. In these cases the membrane may be studded with very numerous tubercles. In the late stages, the thickening may increase and become considerable.

Lastly, a nodular form (König, Riedel), is sometimes met with. It is rare, commonest in the knee. This variety is characterised, in some cases, by the development of a single tubercular tumour in the fibrous layer of the synovial membrane, which may reach the size of a pigeon's egg; in other cases the individual tumours are smaller, and may be numerous. The tubercles lie in the fibrous layer of the membrane, surrounded by small-celled growth and young connective tissue, the nodules are of a pinkish-grey colour, speckled with points, or a pure grey colour, and the normal

synovial epithelium covers them. The joint usually contains fluid in considerable quantity, often melon-seed bodies.

The relative frequency of primary osseous or synovial cases is difficult to determine accurately, but all authors agree in regarding the bone cases as largely preponderating. The proportion varies in different joints and at different ages, synovial cases being relatively more frequent in childhood. König gives the following percentages. All joints—synovial cases, 20 per cent.; hip—synovial cases, 6 per cent; knee, 33 per cent.; elbow, 20 per cent. He also gives the following statistics as to the influence of age in the cases observed in his *Klinik*:—

3–14 . .	Bone cases,	50 . . .	Synovial,	21
14–30 . .	„	„	64 . . .	„	18
30 & over	„	„	39 . . .	„	12

Symptoms.—The local signs will vary according to which of the pathological varieties exists, and they will be so described; but it must be at the same time stated that the different forms may, in their different stages, so much resemble each other that it is often impossible to decide whether the case be primarily a bone or synovial one, without an opportunity be afforded by operation for internal examination.

Primary Bone Cases.—The early symptoms are often extremely insidious. Local pain may exist, and, later, tenderness on pressure or on some particular movements, indicated by limping or interference with free movement of the joint. Local thickening of the bone may be present, or effusion into the joint (as already mentioned, possibly simple) may occur. This effusion may become absorbed with rest, and later will reappear, often with acute local and constitutional signs, indicative of suppuration and infection of the joint. In cases where no adhesions exist, this infection leads to general thickening and pulpy degeneration, with the development of a typical fusiform white swelling. In cases where adhesions exist, a local abscess only may form, with atrophic changes around. Where the original bone-mischief is of the dry or fungating form, suppuration may never occur, the disease being characterised at first by moderate swelling and loss of function, later by deformity due to absorption of bone-ends subsequent to their conversion into granulation-tissue, and extreme wasting of the muscles surrounding the joint. The most typical examples of this disease occur in the hip and shoulder.

Primary Synovial Cases.—Here we have the typical white swelling. The disease usually commences insidiously, at other times with an effusion following a slight trauma. In the case of a joint in the extremities, the typical fusiform swelling now develops, being emphasised by the wasting of the limb above and below the joint. The swelling is doughy and pulpy to the touch, completely effacing all the natural prominences and depressions around the joint; the limb takes up the position characteristic to the joint affected, considerable abnormal mobility from stretching and softening of the ligaments develops, while the normal movements are limited by intra-articular adhesions and the infiltration around the joint. As the cartilages become affected, muscular rigidity prevents passive movement, and the usual night-startings occur. The changes may progress slowly, contraction of the pararticular infiltration giving the skin a white and anæmic look. Abscesses may form in or on the surface of the joint; these are sometimes small and acute, oftener of considerable extent, and of the typical cold variety. It is difficult sometimes to discover any connection between them and the joint. In the later stages these abscesses open, often after burrowing considerably, and long fistulæ, lined with tubercular granulations, remain in connection with a deformed articulation. Such cases may go on for years, at times improving, then relapsing, until finally the last stage is reached. The lymphatic glands above the joints are often enlarged and tubercular, this change being more common in the upper than the lower extremity (Volkmann).

Cases of tubercular hydrops are characterised by the insidious invasion of the effusion, and later by the chronic nature of the thickening of the synovial membrane which persists. The cases of local tumour or nodular thickening are also usually accompanied by considerable effusions. Cases of hydrops may terminate in typical white swellings.

Diagnosis from other joint-affections will be made by the presence of the characteristic diathesis, possibly by signs of tuberculosis in other organs, and by the special course of the case and its pathological peculiarities. The question of primary bone or synovial affection must be made on the lines indicated in the description of the symptoms. The occurrence of local tubercular tumours is to be borne in mind in cases of tumour of the great sac of the knee-joint.

Prognosis.—The general prognosis will depend on the presence of contemporary tubercular disease elsewhere, the general condition of the patient, his surroundings, and his age, becoming proportionately worse with increase in years.

The local prognosis varies with the joint affected, as to its size, accessibility, the possibility of removing the morbid tissue completely, and the nature of the process as to suppuration. The prognosis is best in dry caries, when the joint may heal spontaneously without suppuration. Where moderate localised bone-mischief exists, capable of complete removal, and probably accompanied by limited affection of the joint only, the prognosis is much better than in extensive synovial disease, where complete extirpation of the tubercular tissue is difficult or impossible. Extensive abscesses are bad, and the presence of a sequestrum is also bad prognostically, as necessitating suppuration or opening of the joint. As to the result after spontaneous cure or after operation, in all cases the mobility will be seriously interfered with; in many, complete fibrous ankylosis takes place, and in spontaneous cures considerable deformity is the rule. In all cases, however favourable their course, the possibility of a relighting up of the mischief at the seat of the old deposit is always to be remembered.

Treatment.—The treatment of tubercular joints, in its main principles, differs little from that of other joint-affections, but several points of detail are of extreme importance, and will be shortly adverted to.

The general treatment differs in no particular from that of other tuberculous affections; the special point in the local management is to ensure perfect rest to the articulation, while the patient is confined as little as possible. Rest is, as a rule, best ensured by the application of plaster of Paris splints, except in the case of the hip, where Thomas's splint is more convenient and comfortable. It should be continued for some time after the apparent subsidence of the joint-mischief; interference with mobility must be put up with. In no case should any very active efforts be made to restore free movement, as free manipulations are commonly followed by inflammation and possible relighting up of the tubercular process. This rule especially holds good in the later stages of the disease, even if it has been quiescent for some time; if considerable deformity exist, it is preferable to perform osteotomy of the shaft of the bone in the neighbourhood than to interfere with the joint itself. Thus, contractions of the hip, not amenable to gradual extension or moderate manipulation and, possibly, tenotomy, should be treated by subtrochanteric division of the femur, those of the knee by division of the femur above the condyles.

Counter-irritation, except in the form of iodine paint, is rarely to be made use of. Treatment by rest is especially successful in cases of dry caries, and here, as in cases of synovial disease, the greatest care should be exercised to maintain it, as thereby suppuration is most certainly prevented.

In the majority of cases, however, rest fails to fulfil its object, and here further treatment is necessary, and the relative merits of arthrectomy, excision, and amputation come under consideration. The question of excision or amputation has been considered in the general articles on these subjects, and needs no lengthened mention here; the only special point, that of removing a local infecting centre by amputation, has been alluded to in the general section of this article. The facts there detailed are opposed to the practice.

A few remarks must be made on the special application of arthrectomy and excision.

The main points to be noted in excising tubercular joints are: 1st. The necessity of completely excising the infected synovial tissue, since, if any portion of this or infected granulations remain, the wound becomes re-infected, and the prospect of cure is little better than before the operation. To do this effectively, the incisions must be free, and the scissors are preferable to the sharp spoon, as rather more than the actual granulation-tissue is thus removed. 2nd. To examine the bones with extreme care so as to discover, if possible, the original deposit, and thoroughly to extirpate it by means of the gouge or chisel. As to the employment of excision, it may be said to be applicable only to the hip-joint, and perhaps the elbow, before fourteen years of age; later, it may be performed under the same rules as in other forms of disease.

Below fourteen years of age, except in the hip, and in many cases over, arthrectomy is generally to be preferred. The advantages claimed for the procedure are the following:—No bone being removed, no loss of length follows; the epiphysis not being interfered with, growth is not arrested; the joint in some cases, as the knee, retains its normal outline; it may be employed in some cases where from extent of disease

excision is impossible, and amputation formidable from the amount of limb which must be removed; and lastly, it allows the possibility of a secondary excision or amputation if it should be deemed necessary. In arthrectomy, as in excision, too great pains cannot be taken to completely extirpate the infected tissues, and on the completeness of this the final result mainly depends.

It is usually followed by fibrous ankylosis in varying degrees of completeness. In the after-treatment, it must be borne in mind that deformity occurs as readily as after excision, if a sharp eye be not kept upon the patient. The best dressing, after either excision or arthrectomy, is iodoform. In many cases, either operation is often followed by the persistence of sinuses from reinfection of the wound, most probably due to incomplete removal; such patients may be fit subjects for amputation, or may succumb to some other form of tuberculosis or to amyloid disease.

A more troublesome form of disease to treat is perhaps the so-called hydrops tuberculosis. This disease is not so generally recognised in this country as on the Continent, where the active treatment employed has allowed the surgeon special opportunities of examining these joints at a much earlier date than they come under notice here. In addition to rest and pressure, the first active local measure will be to tap the joint, with a view to relieving tension, preventing injurious stretching of the ligaments, and also obtaining more exact information as to the condition of the synovial membrane. This having been done, considerable difference of opinion exists as to further operative measures. The plan usually followed is to continue the local treatment by rest and support, but Continental surgeons consider that when a diagnosis is established, more active measures are needed. König incises the joint freely, extirpates the infected synovial membrane accessible from the openings, and actively rubs in iodoform to any part of it which cannot be got at with the knife. Volkmann makes such incisions as to allow complete extirpation of the membrane. The partial operation has met with some success in the hands of König; but, as it seems in great measure to depend on the local action of iodoform on the diseased structures left, the writer would suggest in such cases to try the effect of injecting an emulsion of iodoform and glycerine, similar to that used by Mikulicz for spinal abscesses. The mixture consists of glycerine with 10 per cent. of crystallised iodoform shaken up in it. About f℥j. of such a mixture might be safely injected into a joint, since Billroth has injected as much as 100 grammes (containing 150 grains of iodoform) into a spinal abscess without bad result. The mixture must be well diffused by pressure. The success of this treatment in tubercular abscesses, in the hands of Billroth and Mikulicz, would seem to offer a fair probability of good results in joints where the disease is general and no adhesions exist.

The local tubercular tumours have also been removed by incision; this would seem the right treatment, as otherwise the whole joint may become affected by extension.

Tuberculosis of Tendon Sheaths and Bursæ.—Tuberculosis of the sheaths of the tendons may be primary; in the majority of cases it is secondary to disease of the bones or joints. When secondary, it is diffuse, the sheath being lined with fungous granulations, and sooner or later containing pus. When primary, the same condition may exist; in other cases, the deposits are localised in a similar manner to that noticed in the nodular form of tubercular synovitis.

Signs.—An elongated pulpy swelling in the line of a tendon, most commonly met with in the foot, and as a primary condition in connection with the tendo Achillis. At a later date suppuration occurs, and, if not incised, spontaneous opening takes place, with the development of chronic fungating fistulæ. The process may, when the tendon is in the immediate neighbourhood of a joint, affect the articulation by direct extension. More or less widespread local extension is common.

A similar condition may, rarely, affect the bursæ; in other cases, a bursal hydrops, similar in its pathological condition to the joint-hydrops, occurs.

The *prognosis* is not good. Such cases are extremely difficult to heal, and the danger of extension is considerable.

The *treatment* is as complete extirpation as possible with the scissors, and iodoform dressing.

Tuberculosis of Wounds.—Considering the ease with which an acute tuberculosis is produced in animals by inoculation, it seems strange that examples of a similar nature have not been observed in man. Infection, due to cohabitation with a tuberculous person, has been commonly suspected and seen to occur, and although often complicated by the question of occurrence in persons of the same heredity,

taken with similar observations made on animals it is of extreme importance. Evidence of direct inoculation and transference of tuberculosis in man has, however, only been offered during the past few months. The source of such cases would naturally be sought by surgeons among external wounds, and although it has been suggested that infection of internal organs has followed affections of the skin, possibly primarily tubercular in nature, in no case has any proof of the fact been furnished. Secondary tuberculosis of wounds, from extension of existing deposits in continuity with them, is of every-day occurrence; but this never appears to occur if the diseased tissue be wholly removed at the time the wound is made. That this is the case, is rendered the more probable from the fact that none of the chief workers on this subject have ever noted tubercular changes in an amputation wound, when the operation to remove the diseased structures was undoubtedly carried through healthy tissues. This is the more anomalous, since, as a *locus minoris resistentiæ* in a tubercular patient, one would expect to see, at any rate in some cases, the wound take on a tubercular character. During the past year, however, a small number of cases has been published by various observers in Germany bearing on this question. Three (König 1, Kraske 2), are examples of tuberculosis of osteotomy-wounds in young patients, ostensibly in sound health, who were exposed to the possibility of infection by residence with phthisical patients. These cases, however, though of interest, are not convincing, since the two reported by Kraske were osteotomies for deformity, resulting from ostensible osteomyelitis, and, distinct as the signs may have been, considering possible error in diagnosis, they can only be regarded as possibilities. König himself, while putting the third case on record, thinks it of interest rather than as a proof.

Two other observations (Karg, Riehl), have been obtained from another source, one which would have been regarded as likely to offer some valuable information—viz. the hands of those employed in making post-mortem examinations on tubercular subjects. Both patients had so-called post-mortem or butcher's tubercle on the hands and, secondary to this, affection of the lymphatics of the arm. The diagnosis was founded on the histological structure and the presence of bacilli. In neither case is any mention made of inoculation experiments, but, in one, cultivation failed. A third observation (Tscherning) was made in the case of an attendant on a phthisical patient, who wounded her finger, the wound showing signs of tubercular infection spreading to the tendon-sheath and the lymphatics. Examination of the structures again allowed the diagnosis to be made from the structure and presence of bacilli, even in the axillary glands. These cases can of course only be regarded as an elementary contribution to the question; but the importance of the subject warrants their mention. The one striking feature is the local nature of the infection, standing in sharp contrast to the general tuberculosis observed in animals under similar circumstances.

Tubercular Ulceration. — Closely allied to the above subject are those of tuberculosis of the skin and mucous membranes. For some time, the superficial eczema and skin-inflammations observed in so-called strumous children have been regarded as specific in character, while the nature of the process set up in lymphatic glands secondarily affected has led to the supposition that they may be tubercular. The question has become included in the range of practical pathology by the discovery of tubercle bacilli in such a case (Volkmann). The tubercular nature of lupus has long been a contested point; but strong affirmative evidence has lately been adduced in the positive results of inoculation experiments, the discovery of bacilli, the local structure, the co-existence of tubercular disease of other organs, and the cases of general tuberculosis occurring secondarily to it lately recorded by Besnier, Doutrelepont, and Leloir. The observation of Besnier derives special interest from the fact that general infection seemed to follow operative interference. The possibility of the contemporaneous existence of lupus and other tubercular disease is only to be excluded by more extended observation.

Besides lupus, deeper tubercular ulcerations spreading from caseating and suppurating subcutaneous nodules, and from and around lymphatic glands in which similar changes have occurred, are met with; the former are rare, the latter not uncommon.

Tubercular ulcerations, again, are met with in all the exposed mucous membranes; those about the mouth, pharynx, and larynx will be treated of under those headings. An internal ulceration of mucous membrane, of much interest to the surgeon, is that occurring in the bladder. It is nearly always secondary, a typical example of infection by direct extension either from the

testis or kidney. It may be met with in two forms, resembling those seen in the skin—as ulcerations limited in extent, circular in outline, and extremely shallow; or as deep extensive ulcerations, with considerable infiltration of their base. Besides these, the bladder may be the seat of miliary tuberculosis in the acute general variety.

The clinical appearances and characters of these ulcerations will be met with in the special sections. The only points to be referred to here are their resistance to any treatment short of complete extirpation, their liability to recur, and their tendency to attack certain localities.

Tuberculosis of Lymphatic Glands.—This is one of the most common forms of local tuberculosis. It is usually secondary, the result of direct infection from the lymphatics; but cases of primary tuberculosis, occurring by way of the blood-stream, are also described. The possible function of the lymphatic glands as safeguards to the system from general infection is, to a certain extent, illustrated by the situations in which tubercular glands are found. Thus, the most common situations are the neck, the infection coming by way of the lymphatics of the nose, mouth, fauces, and pharynx—parts constantly exposed to danger of infection from without—the bronchial glands and the mesenteric glands, also at the root of the respiratory and alimentary systems respectively; less commonly the glands of the extremities, and here more frequently in the upper than the lower, for what reason it is difficult to determine, since bone and joint cases, their most probable primary source, are equally frequent in either. In the case of the neck, it must be noted that in many instances no primary point of infection can be discovered.

When infection occurs by way of the lymphatics, the glandular affection is local; in cases of general glandular tuberculosis the infection occurs by the blood-stream. The glands present some peculiarities in this case, which will be discussed later.

Section of a tubercular gland reveals appearances dependent on the stage of the process. In the earlier stages, the surface will be of a pinkish or pale grey colour; in some cases, whiter or more opaque spots are visible on minute inspection, or when a magnifying-glass is employed. At this time only moderate swelling will exist, and the gland is still soft. Later, a series of changes occurs. The most common is caseation; this occurs at a number of spots, which tend to coalesce, the gland becoming harder with the development of this process. Section of such a gland may exhibit a number of yellowish areas; when the process is advanced these may be extensive. With the advance of caseation a small-celled new-formation is thrown out around the gland, amalgamating the surrounding tissues with the capsule, blocking up the hilus, and extending along the lymphatic vessels. Where a number of glands are affected, they are in this way amalgamated into one mass, the skin covering them becoming gradually adherent by the extension of the process. Meanwhile, the central portion breaks down, softening extends towards the surface, and a discharge of purulent matter, composed of caseous detritus, shrunken gland-cells, and pus-cells takes place. In other cases the suppuration occurs in the periglandular infiltration, and, when it opens, a tubercular ulcer is formed with the exposed gland lying at the bottom. In such cases healing is slow, occurring only when the whole of the infected gland has been cast off. In place of suppuration, calcification sometimes occurs in the caseating glands, especially in the mesenteric. Caseation, however, is not an invariable sequence; in some cases a fibroid induration develops.

On microscopic examination, such glands exhibit well-marked reticular tubercle; the process commences most commonly in the centre of the gland, and the elements are furnished by hyperplasia of existing gland-structure. Giant-cells are developed between the gland-cells, but in large numbers in the lymphatic vessels, leading to the suggestion, by Mr. Treves, that they are lymph-coagula. Bacilli frequently are not to be found, but they exist in a considerable number of the earlier cases. In Dr. Kidd's cases of phthisis, he found bacilli in glands in six out of thirteen cases; he suggests that the indurated condition of such glands may have something to do with the apparent absence of the organism in the late stages.

In cases of infection by the blood-circulation, tubercles often exist in unaltered gland-tissue.

Signs.—A chronic enlargement of the glands commonly in connection with a primary lesion, the common situation of which has been indicated in the preceding paragraph. The enlarged glands may at first be discrete and free, but, when they have gained an at all considerable volume, they become matted together, lose their distinct outline, and become adherent to surrounding structures. Later, the skin may become implicated, and softening may

result in formation of abscess and fistula. The course may be extremely chronic.

Diagnosis.—The only point of importance is the possible confusion with lymphadenoma. The following particulars are of weight: in both cases a constitutional diathesis exists, the types of which differ, the anæmic appearance, deficiency of red blood corpuscles, rise of temperature, general distribution of the enlarged glands, enlargement of the spleen, and possible hyperplasia in the position of tracts of lymphatic tissue in lymphadénoma, contrasting with the tubercular type, tubercular history, possible concomitant tubercular lesions, and limited distribution in the case of tubercle. Local differences are also well-marked. Individual tubercular glands do not reach so large a size, nor are the collections so large as in lymphadenoma; they tend to suppurate, and are, at any rate, usually surrounded by considerable inflammatory infiltration, neither of which characteristics is met with in lymphadenoma.

Prognosis.—General infection is rare, for reasons already stated. Local prognosis is unsatisfactory; the course is chronic, and recurrences are always possible. If the glands be let run their course, considerable deformity often results.

Treatment.—The constitutional treatment is that of tubercular affections in general; the internal administration of arsenic is sometimes followed by improvement.

Local treatment varies with the stage. The only radical treatment of use is complete extirpation with the capsule. Incision and scraping are likely to be followed by recurrence. Operations should only be undertaken when the glands are not numerous or widespread, and then with a view to obviating the disfigurement likely to accompany ultimate changes, not with the object of removing a local centre. The wounds are best treated with iodoform.

When suppuration and inflammatory infiltration have occurred, the use of the sharp spoon may be inevitable from the implication of surrounding structures. The wounds here should also be dressed with iodoform, all granulations and the mouths of sinuses having been removed.

G. H. Makins.

TUMOURS, Non-malignant. — The simple translation of the word tumour is swelling, and yet the adage that whilst tumours are swellings, swellings are not necessarily tumours, proves that the words 'tumour' and 'swelling' are not convertible, and that, in its technical application, a tumour is something more than, or something different from, a mere visible swelling.

A tumour may be regarded as having *negative* as well as *positive* characters. Of the former, it may be observed that a tumour is not such a swelling as results directly from injury; nor from inflammation, whether of a general or specific form, or involving only some definite structures. Neither is a tumour produced by displacement of an organ, or malformation of any part; nor is it a collection of fluid in a naturally existing cavity, nor a distended condition of some part of a vessel or canal. Hence, traumatic hæmatoma, abscesses, adenitis, gummata, synovitis, hernia, meningocele, hydrocele of the tunica vaginalis, and aneurism, are not tumours in an exact use of the term; although such expressions as 'hernial tumour' are often conventionally employed, as denoting that such a swelling resembles a tumour in some one or more of its positive characters, which are persistency of the swelling, an inherent power of continued growth, and an incapacity either of spontaneous cure or of dispersion by remedial agents of any kind.

In structure, a non-malignant tumour, such as lipoma, adenoma, or exostosis, is of the nature of a localised hypertrophy of a tissue naturally existing in the part. Physically, such tumours may be either subcutaneous swellings, smooth on the surface and more or less closely connected to the tissue or organ in which they are developed, or outgrowths. As regards consistency, they may be either solid, fluid, or mixed, and, if solid at first, they may become cystic, or if fluid at first, the containing cyst may be filled by the growth of an intra-cystic solid tumour.

In the endeavour to define the term non-malignant as applied to certain tumours, it must be observed that this term is a purely clinical expression, and refers to their life-history and to the effects they produce upon the owners. With this in mind, the structure or composition of any tumour may, for the moment, be left out of consideration, and the simplest course will be to state the converse of the signs of malignancy. Innocent tumours do not, when the growth is left to run its course, with unerring certainty destroy the patient's life; indeed, the true state of the case is that, as a rule, a non-malignant tumour exercises no prejudicial influence on the health of a patient. They possess no power of infecting neighbouring parts by an advancing infiltration of the adjacent tissues,

nor of the viscera and distant parts by a subtle deposit of germs of the parent growth, which, in the likeness of the original growth, become new tumours—secondary growths, as they are termed. On the contrary, non-malignant tumours remain always localised even when multiple. Malignant tumours have a distinct proneness to ulcerate; this character is entirely foreign to non-malignant tumours, the skin over which has the same liability to ulceration as, and scarcely more than, any other part. Malignant tumours evince a very constant tendency to recur after removal, in the site of the original growth—a tendency which continues, however frequently the local affection may have been extirpated. Non-malignant tumours are seldom reproduced, and one is tempted to say never, if the whole of the visible growth has been removed.

Cause.—It must be admitted that the usually accepted explanations for the occurrence of tumours are very meagre, and that, in truth, we know very little indeed of any cause based on well-ascertained facts. Developmental errors afford an explanation in congenital hygroma and some dermoid cysts. An excess of formative material in some instances, or a localised hypertrophy in others, may supply a reason for many of the connective-tissue tumours, whilst localised irritation may offer an explanation for the frequency with which tumours are found in similar sites.

The results of obstruction of the duct of a sebaceous follicle may serve to point out how some cysts are formed, whilst the distension of some minute space explains others; and changes, perhaps inflammatory, or possibly degenerative, may explain the growth of a large cyst or a cystic tumour from a small body like a Graafian follicle. For the majority of tumours there seems no satisfactory explanation, nor can we go further than the statement that tumours 'are the result of some inexplicable error in nutrition in the part they affect, and are dependent in the same measure as are the natural tissues on the blood for the appropriate materials of their nutrition.'

Pathology.—A distinctive feature in the histology of a non-malignant tumour is its resemblance to some one or more of the adult tissues of the body, and it has become a pathological axiom that the more complex, the more highly-developed the tissues of a tumour are—the more, in a word, it approaches the type of one of the fully organised normal adult tissues, whether it be fat, gland, or bone—the more surely is its non-malignancy proclaimed; and whilst there are the greatest differences in the frequency with which the various forms of tumour occur, yet instances of all recognised tissues being found in growths are well-established.

It must not, however, be taken for granted that, from the structure of a tumour alone, its malignancy or non-malignancy can be asserted; for quite certainly sarcomatous elements—i.e. such as resemble some fœtal structure—are found in tumours whose general composition is that of one of the non-malignant group, and whose clinical features clearly require that it should be considered innocent. True it is, nevertheless, that, in some instances, features denoting malignancy may be superadded to a growth which, at its commencement, appeared of a simple nature; and, having in view the general similarity that exists between the cells seen in the course of the processes of inflammation (especially those existing during the developmental period) and some typical cells of sarcomatous tissue, surprise cannot be felt that, occasionally, a malignant invasion of an innocent tumour occurs, or that an injured or inflamed part becomes the seat of a malignant growth.

Upon naked-eye inspection, most of the tumours under notice will be seen to be invested with a capsule, which is commonly intimately blended with the growth, but loosely connected to the surrounding structures. Some of the solid tumours are lobed, whilst the cystic may show pouches. As a rule, non-malignant tumours grow much more slowly than the malignant, yet in nearly all tumours periods of active increase occur, and some of the forms of non-malignant tumours attain a great size, notably lipomata; others, again, as the myo-fibromata of the uterus, shrink and may almost disappear coincidently with the cessation of the menstrual function. Degenerative changes, such as calcification, sometimes are noticed, whilst in other forms there is a great liability to the formation of cysts, the result of a process of softening or a mucoid change ending in the formation of definite cavities. In the case of cysts, which at first may seem quite 'barren,' a sort of germinating process begins, and from some portion of the wall a solid intracystic growth sprouts up, frequently going on to fill up and occupy the whole cavity of the cyst or cysts. Whilst some forms of tumours, particularly those formed of erectile tissue, are congenital or commence in the early period of life, some, like exostoses, grow whilst the bony framework is

growing; others again, like the adenoid tumours of the breast or the myo-fibromata, occur chiefly during the period of functional activity of a particular organ, whilst, again, others—for instance, the prostatic adenomata—mark the declining period of life. Putting on one side growths which are more or less peculiar to either sex, on the whole women seem to grow tumours more frequently than do men.

Symptoms and Diagnosis.—The symptoms of an external tumour are objective—due to the presence of a swelling. The diagnosis of a 'new growth' tumour from a swelling which has been defined to have no claim to the technical term of *tumour*, involves an inquiry into history, mode of origin, and physical characters. In most forms of non-malignant tumours, after careful inquiry and examination, a diagnosis is simple, in many it is palpable; occasionally, the history and physical characters are irreconcilable. In such a case, it is nearly always prudent to give preference to the physical symptoms. Again, in a few instances, the physical conditions of a swelling may allow of a diagnosis of some two or three affections; here the probability of the swelling being one of them on the score of frequency should be allowed to prevail. From the circumstances that a simple tumour is nearly always encapsuled, and can be more or less readily displaced from its ordinary position, whilst in an inflamed part everything feels fixed and adherent, it is seldom that an abscess is mistaken for a tumour; yet an error in the opposite direction has equally to be avoided. One must not assume that because a swelling is inflamed, therefore it cannot be a tumour; an innocent tumour, especially when there is some fluid in it, is very prone to attacks of inflammation. In these circumstances, as indeed may be advisable in others, aspiration of the swelling or the extraction of a small portion of tissue, and its examination under the microscope, will often allow of an exact diagnosis being made.

As between a malignant and a non-malignant tumour, the diagnosis turns upon many considerations, but the characters and relations of the tumour are the most reliable. A non-malignant tumour is, as a rule, both more superficially placed, better defined, and more isolated from surrounding parts; the integument is less often implicated in the growth; its rate of increase is much less rapid; whilst the actual period for which a tumour has existed is, if one of years, often well-nigh conclusive evidence of its harmless nature. As it is only in the later stages that a malignant tumour visibly affects the health, too much importance must not be attached to this question, nevertheless loss of weight is a common symptom in all malignant tumours.

Treatment.—Dealing with solid tumours first, it is clear that, for the large proportion, the only treatment is the radical one of extirpation. It would be out of place to describe how this should be done, or to go into any of the subsidiary details connected with the operative procedure, whether relating to patients or their wounds; on this subject all that is requisite being to point out the circumstances which either call for an operation or render it unadvisable, as well as to indicate those tumours that can be more appropriately treated by other means.

As a rule, in non-malignant tumours, surgical interference is a question of expediency, since neither life nor even health is often threatened; where they are, as for instance in ovarian tumours, the risk of a capital operation is justly permitted, otherwise the risk involved by the proposed operation should be measured before deciding in favour of it. Subject to these provisions, the removal of a tumour is to be recommended when it is unsightly or distinctly inconvenient from its position or its size, or is painful, or is obviously growing. In some forms of tumour, the possibility of a cancerous or malignant change supervening should influence the decision in favour of operating. In the absence of any of those conditions, an operation is not to be pressed upon a patient.

On the other hand, when by the removal of a tumour an injury, likely to be attended with permanently harmful results to the patient, may be inflicted upon some structure—such, for instance, as the division of a portion or the whole of a nerve in dissecting out a neuroma, or the laying open a large joint in taking away an exostosis—then in these and similar cases an operation must, as a rule, be refused.

Erectile tumours for the most part only require for their cure that the blood in the dilated vessels should undergo coagulation. This may often be accomplished by electrolysis, styptic injections or setons, or possibly even by compression or ligation of the afferent trunk-arteries. Of the electrolytic treatment of tumours, the writer would venture to express the opinion that it is deserving of a more extended trial than it has as yet obtained.

Completely fluid tumours, particularly those pellucid cysts called hygromata, may

be occasionally cured by repeated aspiration, or, this failing, by the injection of Morton's fluid into the cyst; or a seton may be passed through it. But this is liable to lead to a tedious as well as painful suppurative process, and it should not therefore be inconsiderately put into practice. These measures again may be employed when excision of the cyst is impracticable, but, when it is easily removable, that procedure is the best for most fluid tumours, as well as for those tumours which are partly solid and partly fluid.

ALFRED WILLETT.

TUMOURS OF BONE may be either simple or malignant; the latter are by far the most important, forming about one-half of all the tumours which have their origin in the osseous system.

Taking the simple tumours first, we may refer the reader to the article on EXOSTOSIS for a description of these bony outgrowths or osteomata.

FIBROMATA OF BONE are, comparatively speaking, rare, except in connection with the jaws. *See* JAWS, Diseases of the. They also occasionally spring from the base of the skull, and may hang down into the naso-pharyngeal space. When polypoid in form, such a tumour may be very easily snared by a loop of wire passed through the nose and slipped over the growth by a finger in the mouth. For fuller details as to the tumours in this space, *see* NASO-PHARYNGEAL GROWTHS. In the long bones, the simple fibroma arises from the periosteum, and pushes aside the adjacent tissues, but does not invade them like the sarcomata. Nor does it in any way destroy the bone to the surface of which it is attached. It is very rarely met with, and can only be diagnosed from a periosteal sarcoma by the length of time that it has existed, by its uniform consistence, smooth surface, and perfect freedom from pain. If a reliable history can be obtained which proves beyond a doubt that it has been of an excessively slow growth, the proper treatment will be to remove it from the bone without interfering with the integrity of the shaft. It must, however, always be remembered that it has a very close affinity to the spindle-celled periosteal sarcoma, for which the limb must be removed at a considerable distance from the growth. Some of the periosteal sarcomata, having a large admixture of fibrous tissue, and being in consequence exceedingly dense and firm in structure, resemble very closely the fibromata. These have been called fibro-sarcomata, and are more fully described in the latter part of the article SARCOMA.

ENCHONDROMATA OF BONE, when purely cartilaginous, are simple tumours which do not return after their complete removal. If such a tumour shows the characteristics of a malignant growth, it is almost certain that the cartilage is mixed with other embryonic tissues, and is practically a chondrifying sarcoma. An enchondroma in most cases, closely resembles hyaline cartilage, which presents itself in a more or less embryonic form; but it may have a varying amount of fibrous tissue in its matrix, and in this way simulate fibrous cartilage. Calcification and ossification may also take place, and, in the latter instance, partly convert the tumour into an osseous growth. An extreme example of this change is seen in the cancellous exostosis (*see* EXOSTOSIS), which is generally covered by a layer of cartilage, and increases in size by the ossification of its cartilaginous cap. Fatty and myxomatous tissue are also not uncommonly present, especially in the larger tumours (chondro-myxoma). These changes may convert different parts of the growth into a soft and diffluent mass, and even produce distinct cystic cavities. Since the microscope has been more generally used for the minute and thorough examination of all new-growths, it has been found that, even where the tumour appears to the naked eye to be almost entirely composed of cartilage, a certain admixture of the other embryonic tissues may be discovered. It is also known that a sarcoma of bone may, in part, be converted into cartilage. Putting these two facts together, most surgeons believe that, where an enchondroma returns after removal, or is widely disseminated in the glands and viscera, the case is not one of simple enchondroma, but a mixture of two growths, both starting from embryonic tissue, or more probably a sarcoma in which a part of the embryonic tissue has become cartilaginous—i.e. a chondrifying sarcoma. In former days it was very probable that the sarcomatous element would be overlooked, when the tumour appeared to be almost entirely composed of cartilage.

Situation.—The pure enchondromata of bone are most commonly found arising from the phalanges or metacarpal bones. They are then frequently multiple, so that a patient may have one hand distorted by several of these tumours. Both hands and both feet may be similarly affected, but it is far more common in the former than in the latter. Though often multiple

these enchondromata are generally small, but their size is quite sufficient to very seriously interfere with the functions of the hand or foot. These small multiple enchondromata usually arise in the medullary cavities of the smaller bones just named, so that a complete shell or plates of bone are generally found upon the surface. A cartilaginous tumour arising on the other and larger bones is always single, and may assume enormous proportions. The scapula and pelvis are common sites for these growths, so also are the adjoining parts of the femur and tibia; but scarcely any bone in the skeleton can be said to be free from the possible development of an enchondroma. In these cases they generally grow from the periosteum, and are consequently attached in many cases only to the surface of the bone; but the latter may be partially absorbed by pressure. Many of those enormous tumours which are described in our surgical literature as enchondromata would, in the present day, be classified as sarcomata, for the reasons that have been already stated at the commencement of this article.

Age.—The multiple tumours of the hands may occur either during childhood or in the young adult, but the majority arise before the age of puberty. With regard to the single and larger growths, they are generally seen at a somewhat later period of life, but it is difficult to form any decided opinion as to the usual limits of age, on account of the uncertain nature of the tumour in most of the recorded cases.

Diagnosis.—A cartilaginous tumour is globular in outline, with a slightly lobulated surface, but this is nevertheless perfectly smooth in each of its larger and smaller subdivisions. Its consistence may vary from a very dense and solid growth to one which, with some confidence, may be thought to be in part cystic. The outline can be very clearly felt, being distinctly circumscribed, and, as there is no infiltration of the surrounding tissues, the skin and muscles may be made or seen to move without traction upon the tumour; in its simplest form it merely pushes aside the overlying and adjacent structures, without invading them in its growth. As a general rule, it is perfectly painless, unless some nerve be accidentally stretched or pressed upon. There is consequently no inconvenience complained of except from its weight and size. It is exceedingly indolent and slow in its growth, occupying many years in attaining any great size. Rapidly growing enchondromata have been described and thought to be a malignant type of cartilaginous tumour, from the fact that they sometimes returned after removal either in the site of operation or in the glands and viscera; but, as has been before explained, it is very doubtful whether they are not sarcomata in which chondrification had taken place.

The enchondromata of the hand, whether multiple or single, do not, as a rule give rise to any difficulty in diagnosis. The age at which they occur, the particular bones affected, their central position in these bones, their slow growth and freedom from pain and tenderness, combine to make the diagnosis tolerably easy. The consistence may vary considerably in different parts, so that a deceptive sense of fluctuation may at times be detected; but although in such instances the bone has evidently been perforated by the growth, osseous plates will be found in some parts of its surface, and the general impression will be that of an elastic central growth rather than a fluid tumour. In its early stages it might possibly for a time be confused with a so-called 'strumous phalanx,' which is also most commonly seen in childhood. The metacarpal bone may be affected in a similar manner by a strumous ostitis. But in the latter cases some signs of inflammatory infiltration would be felt in the superficial structures, and tenderness on pressure. The enchondroma, though globular in its general outline, has usually small rounded projections on its surface; but the skin and superficial structures are never infiltrated and adherent to the parts beneath, as in the strumous disease of the phalanx and metacarpal bone. As time goes on and suppuration takes place, some shortening of the bone is produced and the swelling diminishes in size, whereas the enchondroma steadily increases without any signs of inflammation or suppuration.

Syphilitic disease of the phalanges, which is seen in young children, is generally distinguished by the fusiform enlargement of the whole bone without any tendency to suppurate, and by the history and other signs of syphilis. It has never the globular outline of an enchondroma, nor its elastic sensation on pressure. The tumour also only occupies a part of the bone, and generally one of its extremities.

The larger enchondromata, which occur in other parts of the skeleton, may give rise to greater difficulty, for although we may be able to say that a given tumour contains cartilage, yet we cannot always feel confident that this is the particular tissue which controls the sequel of the case. As has been

already pointed out, the cartilage may be in part ossified, but this and other simple changes are of less consequence than the possibility of the presence of sarcomatous elements in its structure. The real difficulty in these cases will lie between the simple periosteal enchondroma and the chondrifying periosteal sarcoma. The history will generally be the most important point in the decision of this question.

The rapidity of growth in the case of the enchondroma is commonly measured by years; whereas, in the sarcoma, months, or even weeks, produce a visible alteration in the size of the tumour. Pain is also frequently complained of in the sarcoma, and in some cases is a very conspicuous feature, keeping the patient awake at night for many hours; an enchondroma, on the other hand, is, as a general rule, quite free from this distressing symptom, and only gives rise to inconvenience from its size.

In an enchondroma there should be no infiltration of the surrounding parts, so that the tissues ought to move smoothly and easily over the tumour, whereas in the malignant growth the reverse is generally the case.

The *treatment* of a simple enchondroma depends somewhat on the part that is involved and the inconvenience which it causes. In the hand, the tumour may sometimes be removed without the loss of the bone, but it can only be done where the growth has not converted the shaft into a mere shell. The writer of this article excised an enchondroma from one of the metacarpal bones, which had grown from its medullary cavity but projected only on the flexor aspect, leaving the cortex of the shaft on the dorsum perfectly free. The tumour was removed from the flexor side, and the thin strip of cortical bone left *in situ*. The patient recovered with the perfect use of his hand, and no recurrence took place. But, as a general rule, the bone is so disorganised that the whole of it has to be taken away. Amputation of the finger with its metacarpal bone, if the latter be involved, is therefore the usual method of giving relief where an operation is required. It must, however, be remembered in these cartilaginous tumours of the hand that the growth is, after all, benign, and that it generally ceases to increase before it has attained a large size. Consequently, when it does not interfere with the usefulness of the hand, it may be wiser not to remove a part of so much importance as a whole finger with its metacarpal bone, unless the patient is himself exceedingly anxious to have it done on account of the deformity. On the other hand, if a finger is already disabled by such a tumour, it had better be removed.

It is difficult to lay down any rules for the large single enchondromata which grow from the long and flat bones, such as the femur and scapula, for they differ very much in their importance. One that is slowly but steadily increasing should be removed, for it may in time assume such a size as would, from the magnitude of any subsequent operation, of itself endanger life, and one can scarcely estimate the inconvenience and disability to which it may eventually give rise. An exploratory incision may be made to see if it can be removed from the bone to which it is attached. In some cases, it may be taken away without destroying more than a limited portion of the bone from which it grows; in others, the shaft of a long bone may be so injured as to necessitate the amputation of the limb. An enchondroma of moderate size, attached to one of the larger bones and perfectly stationary in its growth, may, for a time at least, be left without interference, particularly if its removal would entail some loss of function in the part to which it is fixed. But the patient should be cautioned as to the possibility of its increase, and the necessity in that case of again consulting his medical adviser. When, however, a tumour appears on examination to be an enchondroma, but yet has increased very rapidly in size and shown other signs of being malignant, it should be treated like a sarcoma, and the limb be removed at once well above the seat of the disease.

Sarcomata of Bone.—General articles on Sarcoma and Malignant Tumours affecting all the tissues and organs, but not especially referring to bone, are given elsewhere. Although this subject has been discussed in the manner indicated above, yet it is thought desirable to give more fully in this article an account of the sarcomata in their special relation to bone, for they are by far the most important of the tumours which start in the osseous system. It will not be necessary to again describe the structure of the different varieties of these tumours.

Cause.—The theories as to the etiology of these growths have been very fully discussed under Malignant Tumours, and it is here only necessary to emphasise a fact of some clinical importance—that a very large proportion of the sarcomata of bone are traced by the patients to some definite injury, such as a blow, a kick, or a fall.

Central and Peripheral Sarcomata.—These may start from the centre or from the surface of a bone, and it is exceedingly difficult in some of the flat bones, such as the skull, scapula, and ilium, to say where the tumour commenced. But in the long bones there is not, as a rule, any difficulty in distinguishing between the two, even during life. The parosteal tumours, or those which are connected with the outer layer of the periosteum, will not be included in the periosteal or peripheral tumours of bone, as it is probable that they only secondarily invade or become attached to the periosteum. The periosteal or peripheral sarcomata develop generally from the osteogenetic layer of the periosteum, and are especially prone to be in part calcified or ossified. The bone itself upon which they are seated may be normal or itself invaded by extension through the Haversian canals.

Mr. Butlin has ably pleaded against the use of the word 'osteoid' in relation to these changes of structure in the periosteal sarcomata. We have no space here to produce his arguments against the term 'osteoid,' which 'implies the presence of a substance like bone, yet not bone.' Suffice it to say that ossifying, calcifying, or chondrifying sarcoma is distinctly more correct, and at the same time more nearly expresses the changes that may occur in the periosteal growths. An equal objection may be taken to the word 'osteosarcoma,' which has been used with very various meanings. After removal, these tumours, which spring from the periosteum, have in most instances a distinct radiation from the bone upon which they are placed. The columns or lines appear to be produced by the calcification and ossification round the small vessels which run from the periosteum at right angles to the bone. As the tumour increases in size, the periosteum is farther removed from the bone, so that the area in which this radiation and subsequent ossification or calcification may occur becomes larger, and occupies a greater part of the new-growth. But bone is never found in the capsule or outer part of the tumour. The central sarcoma starts in the medullary canal, and gradually approaches the surface by destruction and expansion of the bone within which it grows. As it reaches the surface, the periosteum, irritated by its presence, produces new bone to encapsule the growth; so that, as it increases in size, a shell of new bone is still found upon its exterior. This is the distinguishing feature both in a clinical and a naked eye examination of the difference between the central and peripheral tumours of bone. This encapsulating shell of bone is, however, rarely complete, and may only be represented by a few osseous plates.

The microscopical and naked eye appearances of the different varieties of Sarcoma will be found under the article of that name, and need not be repeated here. The round-celled, spindle-celled, mixed-celled, and myeloid sarcoma, which is the classification there adopted, may each of them attack the various parts of the human skeleton. The last one only of the group is confined, almost entirely, to the tumours arising from the gums and the cancellous parts of the bones, whilst the other varieties may be found equally in the central and peripheral sarcomata. From a perusal of the article just alluded to, the reader will find that other subdivisions might be made according to the secondary changes to which many of them are liable. It is here only necessary to mention those which are of practical and clinical importance. One form, in which there is often a large development of bone, has been already mentioned in describing the periosteal sarcoma. Cartilage may also be found, and is especially referred to under *Enchondroma*. The cystic and vascular conditions which are sometimes found are of still greater importance, as they are liable to be misunderstood. These tumours are all of them, but especially the central sarcomata, liable to degenerative changes. They may be in part cystic, myxomatous, or fatty, and the possibility of these conditions being present must not be forgotten in an examination of any particular case, as it will give rise to different degrees of density in various parts of the growth. The central sarcomata are also often exceedingly vascular, a circumstance which at one time leads to hæmorrhages into its substance, and at another to distinct pulsation. In an analysis of 165 cases of sarcoma of the long bones by Gross (*American Journal of Medical Science*, July and Oct., 1879), it appears that pulsation was noticed in twenty per cent. of those that were central; whilst in the flat bones, such as the skull and innominate bones, it has been very frequently observed in both the central and peripheral tumours. But of all the sarcomata of bone, it is perhaps most common in those cases in which several bones are simultaneously affected.

The malignancy of these sarcomata is shown by their tendency to return locally after removal, by the occasional invasion of the lymphatic glands, and by the frequent occurrence of deposits of the same growth

in distant viscera, especially the lungs. But they differ very much in the degree of malignancy which the various forms present when arising from bone. Some sarcomata invariably return locally or appear elsewhere, no matter how early in the course of the disease or how far removed from the seat of the tumour the operation is performed. On the other hand, the myeloid sarcomata so seldom return after removal that some surgeons look upon them as benign growths, and have even urged that they should be merely scooped out from the bone in which they are embedded. But of their occasional recurrence, especially after this latter operation, there can be no doubt, so that they must still be looked upon as malignant tumours. The following table, taken from Gross's article on 'Sarcoma of the Long Bones,' already quoted, shows this point extremely well. It will be seen by this analysis, which is based upon a study of 165 cases, that the periosteal growths are much more malignant than the central sarcomata, and that these again each differ considerably amongst themselves; so that the periosteal spindle-celled sarcoma appears at the head of the list as the most malignant of all, and the central myeloid at the other end of the list, as the most innocent or least malignant of all sarcomata arising in bone:—

Variety of Sarcoma	Infection of adjacent tissues, as shown on dissection after removal	Local recurrence after operation	Infection of glands	General infection
	per cent.	per cent.	per cent.	per cent.
Periosteal spindle-celled	44	60	—	100·
,, round-celled	50	50	7·69	66·66
,, osteoid (?ossifying)	40	41	6·25	65·62
Central round-celled	66	25	8·33	33·33
,, spindle-celled	18	20	—	23·07
,, giant-celled	12	8	—	22·72

The invasion of the lymphatic glands is not by any means a common occurrence, and would seem, from its rarity, to be due in most cases to the chance position of the primary growth. Thus, it is much more common when the tumour arises in the bones of the pelvis or skull than when it starts in any of the long bones. In the pelvis it is probably due to the direct implication of the glands, which are so numerous in this region, and, when once any gland is involved in the infection of the adjacent tissues, the disease may easily be carried on to the others. In the skull several tumours may simultaneously arise, or many of the bones and viscera be affected by the same growth. The blood-vessels in such cases must be looked upon as the medium through which the disease is disseminated. Indeed, there is but little doubt that this is the ordinary way in which the viscera become the seat of the secondary tumours. The lungs are far more frequently affected than any of the other organs, a fact which strongly supports this view of the means by which general infection of the system is produced. As is shown by the table quoted above, the percentage in which this general dissemination of the disease occurs is much higher in each variety of sarcoma than that of the local recurrence after operation.

Although most commonly seated in the articular extremity of a long bone, the joint is very rarely invaded. The bone may be almost completely destroyed, forming a mere shell around the growth, or represented by a few bony plates upon its surface, but the cartilage still opposes a barrier to its entrance into the joint. Cases are, however, recorded in which the tumour has passed through the joint, and invaded the opposite bone entering into the articulation. In the periosteal sarcomata the invasion usually takes place through the synovial membrane, but in this case also it is a very rare occurrence.

The *favourite seat* of both the central and periosteal sarcomata, if we exclude the jaws, which have been considered in another article, is the articular extremities of the long bones, and one epiphysis is more likely to be attacked than the other. For example, it is much more common for a sarcoma to arise in the lower end of the femur and the upper end of the tibia than in any other parts of these two bones. To quote again from Gross's admirable article, it will be seen that out of 165 cases which he analysed,

The femur	was the seat of the disease in	67	instances
The tibia	,, ,,	46	,,
The humerus	,, ,,	25	,,
The fibula	,, ,,	13	,,
The ulna	,, ,,	7	,,
The radius	,, ,,	6	,,
The ulna and radius were	,, ,,	1	instance

Thus the bones of the lower extremity are far more frequently affected than those of the upper, the femur, tibia, and fibula being the seat of the disease in 76 per cent. of all his cases.

It is interesting also to note, in an analysis of the histological structure of the tumours in these same cases, that the myeloid or giant-celled sarcomata formed about 42 per cent. of the entire number, and that the central tumours collectively exceeded the periosteal by about 18 per cent. We have already shown that the central are less malignant than the periosteal sarcomata, and that, of the central growths, the giant-celled are the least likely to show any malignant tendency.

Symptoms and Diagnosis.—The sarcomata of bone occur chiefly at an early age, by far the larger proportion developing before the thirtieth year. Their favourite situation has been already discussed. The external contour of these growths will vary with the position and nature of the tumour. The central are generally spherical in outline, wherever they may be situated, whilst the periosteal sarcomata are long and fusiform in the shaft, and pyriform at the extremities of a bone, with the base directed towards the articulation. This gradual diffusion along the shaft is very characteristic of a peripheral sarcoma. The periosteal tumour may be situated at first only on one side of a bone, although, as a rule, it quickly surrounds it in its further growth. The central will have a distinct bony capsule or numerous bony plates upon its surface, and, if the tumour be soft and cystic, will often yield a sensation of 'egg-shell crackling.' The periosteal growth will be smooth or tuberous, with no bony plates upon its exterior.

In either case, the density and resistance to pressure will probably vary in different parts, the tumour being in some cases exceedingly firm and in others so soft as to give rise to a doubtful sense of fluctuation. But the growths may also be uniformly hard or soft throughout, or even in part distinctly cystic. Pulsation is of fairly frequent occurrence in the central tumours of the long bones, and is also found in some of the multiple periosteal growths of the flat ones. If pulsation is felt in the articular extremity of a long bone, it may fairly be assumed that the case is one of central sarcoma. It has happened to the writer to have to treat a case of pulsation over an area of about half an inch in diameter on the inner surface of the head of the tibia, in which there was no expansion of the bone and no tumour to be detected. In submitting this case to operation, the whole of the interior of the head of the tibia was found excavated and replaced by a soft, almost fluid, and highly vascular pulp. This, on careful examination, proved to be a myeloid sarcoma. The size to which these tumours may grow varies enormously, and no opinion can be formed as to their nature from this circumstance alone. Some, while still quite small, will have produced general infection of the system; whilst others, which have assumed gigantic dimensions, may yet not return after complete removal. Spontaneous fracture may occur in either the central or peripheral form of growth, and in some cases is the first indication of the disease. If no swelling has been previously present, it very quickly appears on the occurrence of the fracture. In those periosteal cases in which calcification or ossification takes place, this accident is not likely to happen, but in the softer tumours, which extend through the Haversian canals, eroding the bone, it is as prone to occur as in the central sarcomata. Pain is almost always a prominent symptom, and is sometimes very severe, making life so intolerable that, on that account alone, the removal of the part affected may seem desirable. It is perhaps less frequent in the myeloid tumours, but in the other forms of sarcomata of bone it is almost invariably present, in more or less severity, throughout the course of the disease. Pain is, indeed, often the first symptom which attracts the patient's attention to the presence of a swelling, and should always be looked upon as of gravest import when it cannot be traced to the distribution of any definite nerve-trunk. In the latter case a simple tumour might, from its accidental position and pressure, be the origin of the pain.

The rapidity with which the sarcomata of bone increase in size, and the duration of life without operation vary enormously. It is, however, upon this symptom that the diagnosis chiefly rests, and it would be, in most cases, impossible to distinguish the sarcomata from the simple tumours of bone, without knowing the length of time that the swelling had existed. As a rule, the rate of increase is, in the former, measured

by months or even weeks, and in the latter by years. In some instances there may be a kind of pause in the rapidity with which the disease advances, but, generally, the increase is uninterrupted in its progress till death occurs, in from one year to eighteen months in the case of the more rapidly growing tumours, whilst in the more chronic forms life may be prolonged for two or even several years.

The diagnosis of a sarcoma from an innocent tumour of bone is generally easily formed from the history of its rapid growth, from its varying consistence in different parts, from the constant presence of pain, and from the well-known fact that it is of much more frequent occurrence than any other kind of growth in bone. Some difficulty will occasionally arise when the tumour is exceedingly firm, of considerable size, with a clearly defined margin and a lobulated surface. If of slow growth, such a tumour would naturally be considered to be a simple enchondroma; when, however, it has been rapidly increasing in size, the probability will be in favour of a sarcoma which is chondrifying; and if it be seated in the articular extremity of a long bone, such as the lower end of the femur, the probability will approach a certainty, as may be gathered from the remarks in the preceding paragraphs.

In very rare and exceptional cases, some forms of inflammation of bone may be mistaken for sarcoma, especially as a hectic temperature is not unknown in some instances of the latter affection. The soft tissues in the rapidly-growing variety of sarcoma may also be hot, œdematous, and infiltrated, as if from inflammation. The converse also takes place, in which the inflammatory affection is of such a chronic type as to simulate very closely the early stage of a central sarcoma of bone. Mistakes of this kind have been made, and could not, apparently, have been avoided. They have mostly been described under the name of 'necrosis without suppuration,' to which and its clinical distinction from sarcoma a reference will be found in the concluding paragraph of the article on Sarcoma. In any doubtful case the tumour should certainly be incised, and, if necessary, the bone trephined, so that no time may be lost in excluding or confirming the presence of a malignant tumour. There should be no difficulty in distinguishing a sarcoma of the articular extremity of a bone from disease of the neighbouring joint; for, even in the rare cases of invasion of the articulation by the new-growth, to which allusion has been previously made, the occurrence only takes place in the later stages of the disease, when the diagnosis will probably have been already made. In the case of the tumour, the joint will not be uniformly enlarged nor form the centre of the swelling; its freedom of movement will not be much, if at all, impaired; no pain or grating will accompany its action, and no improvement will be produced by the perfect rest obtained from a splint, but, on the contrary, the tumour will continue to increase in size.

Pulsating tumours of bone will be found discussed under Osteo-aneurism, but there is very little evidence to show that there is any other growth in bone giving rise to pulsation, except the sarcomata which have been already described. From an ordinary aneurism in the groin or popliteal space, the diagnosis may at times be attended with considerable difficulty. The points, however, of importance would be the situation of the tumour, which might be out of the line of the vessel supposed to be affected, the incorporation of the growth with the bone upon or within which it is placed, the presence in many cases of bony plates upon its surface, the ill-defined outline in the periosteal form of growth, and the less impulsive character of the pulsation as contrasted with that of an aneurism. The arterial pulse below—as, for example, at the ankle—will be altered or possibly absent in the case of aneurism, whereas, in the pulsating sarcoma, it will be of the same size and character as that of the corresponding artery of the opposite limb. On compressing the artery above, the tumour also cannot be much diminished in size by pressure, whereas the aneurism may be partially emptied, and the solid growth may be more easily felt and appreciated. That it is, at times, exceedingly difficult to distinguish between the two in the situations mentioned above, is evidenced by the fact that arteries have been ligatured by the most experienced surgeons for tumours supposed to be aneurisms, which have subsequently proved to be pulsating sarcomata.

Treatment.—Amputation at the earliest possible moment, whenever it is possible, is undoubtedly the proper treatment to pursue. The only question of importance is the site of operation. Even in those cases where we know that the growth will almost certainly return elsewhere, the limb should still be removed if the patient is suffering any pain. And there are very few cases in which pain is not experienced, which steadily increases in severity, and may be entirely

relieved by operation. The best plan will be to take the individual bones *seriatim* and to discuss the operation which the writer thinks most suitable for the sarcomata which affect them.

In the case of the *tibia* and *fibula*, which may be taken together, much will depend upon whether a decided opinion can be formed as to the central or peripheral origin of the growth. The periosteal sarcomata should be very widely removed, as they have a great tendency to infiltrate the surrounding tissues. Consequently, when it is quite clear that the growth is a periosteal one, there should be no hesitation in amputating through the lower third of the thigh or through the knee-joint, unless there is plenty of room between the tumour and the part immediately involved in amputation below the knee. If a periosteal growth involve only the lower part of the tibia or fibula, either of the two latter operations would be feasible, provided there is a very large margin of healthy tissue between the flaps and the tumour. There is no reason to suppose that the tumour would be likely to return in the stump of the tibia in the amputation below the knee if these conditions be observed; in fact, experience rather proves that the disease more frequently returns elsewhere. But there are very few cases of sarcomata in this position which, when they come under observation, have not made such rapid progress as to require the higher operation; and, as a general rule, an amputation through the lower third of the thigh should be preferred to one below the knee. If, however, the case is one of periosteal sarcoma in the upper end of the tibia or fibula, an amputation through the middle of the thigh would probably be indicated, as there would scarcely be room to form healthy flaps in an amputation through the lower third of the femur.

The central sarcomata will allow of more lenient treatment, on account of their malignancy being of a less marked character. An amputation may therefore almost certainly be performed below the knee in a case of central sarcoma involving the lower ends of tibia or fibula, but the sawn surface should be carefully examined, for fear of any extension of growth along the medullary cavity. If this be found, it would be best to complete the operation by removing the upper end of tibia and fibula—in fact, by amputating through the knee-joint. For a central sarcoma of the upper end of tibia or fibula, amputation through the lower third of the thigh would probably be sufficient, if there were plenty of room for the flaps. In the middle of the shaft, the central sarcoma is likely to be of the round or spindle-celled variety, which is more malignant than the myeloid. It would, therefore, be wiser to give more space between the growth and the site of operation. As regards the enucleation of a central sarcoma from the bone in which it is situated, it is, in the writer's opinion, a very doubtful policy. In most cases, the bone is reduced to a mere shell after the removal of the growth, and, even if successful, so far as the tumour is concerned, enucleation would be unlikely to leave a leg capable of bearing any weight in walking. There is also another danger, which occurred to the writer of this article. The tumour will very probably encroach so much upon the neighbouring joint that, after its removal, the cartilage only may be left between the cavity in the bone and that of the joint. In the case referred to, amputation had to be performed a week or two after the first operation on account of a secondary synovitis, and, when the limb was removed, the condition described above was found. The patient made an excellent recovery, and has had no recurrence of the disease up to the present time, which is two years since the removal of the limb. Resection of a central sarcoma of the fibula, with the part of the bone affected, has been successfully accomplished by Langenbeck, and might certainly be attempted if the disease were not too far advanced; but the tibia could scarcely be so treated, although in the case of a myeloid sarcoma the disease would probably not return.

If there is any doubt as to the nature of the growth and the consequent site of operation, it would be best to make an incision into the centre of the tumour, when its endosteal or peripheral origin would be decided, and the amputation selected on the lines indicated above.

In the *femur* there is much less choice of operation, but the same rules which have been already mentioned will guide the surgeon aright. The periosteal sarcoma of the lower articular extremity of the femur will require an amputation as far removed from the seat of the tumour as is consistent with safety to the patient's life. If it has already spread along the shaft, the limb should be removed just below the trochanters. If the disease be seated in the centre of the femur, nothing less than amputation at the hip-joint ought to be entertained, but the mortality after this operation is exceedingly high. It is right, therefore, considering the immediate danger to life,

that the nature of the case should be fully explained to the patient or his friends, so that they may judge whether the risk is worth running in view of the very probable return of the disease, to which a glance at the foregoing table will recall the reader's attention. What difference the various later modifications of amputation at the hip-joint will make in the immediate risk to life, future experience must prove. In the ordinary flap operation, the soft tissues are retained. Furneaux Jordan's method, which is so suitable for cases in which excision of the hip has been unsuccessful, is also objectionable in periosteal sarcomata for the same reason. Cutting short flaps from without inwards, and retaining as little of the deeper tissues as possible, would probably be the best for the patient, so far as recurrence of the growth is concerned. The immediate risk to life from shock might then be avoided by sawing through the trochanters instead of disarticulating at the hip, provided of course the growth did not extend too far along the shaft of the femur to make this modification of the operation undesirable. For a periosteal sarcoma of the upper extremity of the femur no operation ought, in the writer's opinion, to be undertaken. The patient would almost certainly succumb to the direct effects of the treatment, if the operation were sufficiently extensive to take away the parts infiltrated by the disease. The sarcoma would also probably return in the stump before the wound had closed, and little or nothing would have been gained by the operation.

The central tumours may be treated, as in the case of the tibia and fibula, with greater leniency, particularly if there is reason to suppose that the case is one of myeloid sarcoma. A much larger proportion of the central growths are limited to the lower epiphysis of the femur than is the case in the periosteal sarcomata. They are, also, much less likely to be diffused in the surrounding tissues, so that an amputation through the middle of the thigh will, in most cases, be sufficient for a central tumour of the lower epiphysis. The sawn surface of the femur must be carefully examined, and if there be any doubt as to the possible extension of the disease along the medullary canal, another section must be made till a perfectly healthy part is reached. For a central tumour of the middle of the shaft, amputation through the trochanters or a disarticulation at the hip might be performed; the decision, as to which would be the best operation, being made according to the special features of the case.

For a central tumour in the upper end of the femur, disarticulation at the hip-joint should certainly be undertaken, if there be any chance of the patient surviving the immediate risks of the operation. This would give by far the best prospect of permanent recovery from the disease; but if, from any special reason, this was thought undesirable, resection of the head, neck, and great trochanter might be attempted. The immediate risk to life would probably not be so great, but the subsequent progress of the case would be much more exhausting to the patient's strength than in excision for disease of hip, and recurrence of the growth would be more likely to take place than after amputation. Still, if the disease were not too far advanced, it would certainly be right to give the patient this last chance, in the case of a central sarcoma of the upper epiphysis of the femur. It is well to bear in mind that the hæmorrhage in such an operation would probably be very considerable, if one may judge from the records of cases of resection for sarcomata in other bones.

In the *forearm* the same distinction should be made between the central and peripheral tumours, the latter requiring amputation through the elbow or just above the condyles of the humerus, according to the position and extent of the primary growth. In some of the rapidly growing periosteal tumours, the disease extends very quickly along the muscles and their sheaths. Where this appears to be probable, from the infiltrating nature of the growth and its rapid increase in size, the amputation should be done at the junction of the middle and lower third of the arm, above the humeral attachments of the muscles of the forearm. The central sarcomata are almost entirely limited to the lower third of the radius and ulna, and may in many cases be removed by enucleation or resection. In the case of the ulna, the latter operation is particularly favourable, as it may be done without opening the wrist-joint. Should there be a doubt as to its central or peripheral origin, an incision ought to be made and the finger introduced, for if it proved to be a central sarcoma, but yet too extensive for enucleation or resection, amputation might still be performed through the upper third of the forearm, if the soft parts were not already infiltrated.

In the *humerus*, disarticulation of the shoulder-joint will probably be required for

both forms of disease. The periosteal, which is nearly always situated in the shaft of the bone, must be treated in this manner on account of the principles already enunciated in speaking of the other bones; and the central, which, with very few exceptions, has its origin in the upper epiphysis, most frequently requires this operation from the large size and extensive nature which a central sarcoma so rapidly assumes in this position. Resection of the upper end of the humerus has been performed with a large portion of the shaft, but hitherto, so far as the writer has been able to learn, without success. In the amputation, the skin only should be retained, especially in the periosteal cases, as there can be no object in keeping the deltoid. The outer half of the clavicle and a portion or the whole of the scapula have also been removed at the same time, where these parts were involved in the disease.

Portions of the *pelvis* may at times, in quite the early stage of the disease, be capable of removal, but the possibility of doing this will always be exceptionally rare. The same may be said of the *clavicle* and *sternum*. The *scapula* has been more frequently attacked by the surgeon's knife for sarcoma. The inferior segment, when that alone is involved, may be very rapidly and successfully removed; but the excision of the whole scapula, with the arm and outer portion of clavicle, is a very formidable operation, comparable in its results with disarticulation at the hip. The new growth is also almost certain to reappear in the lungs.

The *prognosis* of the sarcomata of bone may be gathered from what has been previously said as to their malignancy. But, after the tumour has been removed and examined, a much safer opinion can be given as to the probable result. It would be wiser, therefore, to withhold any definite opinion till the necessary operation has been performed.

If the tumour proves to be a myeloid sarcoma and has been very freely removed, every hope of a permanently successful result may be entertained. But if it has only been enucleated or resected, a definite opinion, with our present knowledge and experience, must still be withheld for a time. Should it return, amputation may yet be performed with every hope of permanent success. The other central tumours, although more favourable than the periosteal, are not so benign as the myeloid. According to Gross, if calcareous or osseous deposits are found in *any* of the central sarcomata, they are much more likely to recur. If, after removal, the periosteal nature of the tumour is confirmed, the prognosis becomes much more grave, as the majority return either locally or by general dissemination; in the spindle-celled variety, metastasis occurred in Gross's cases in the proportion of 100 per cent.

Cystic Tumours of Bone may be divided into four classes—

(1) Those which are connected with the teeth, and which will be found described under Jaws, Diseases of the.

(2) Those which are due to some other and more important growth. They are here only an accidental formation, and must not be considered apart from the disease in which they arise. For example, they are found in the enchondromata, especially in the myxomatous variety. Cavities, containing serous and bloody fluid, are also not uncommon in the central sarcomata, and were often described in former days under the name of 'spina ventosa.' The large majority of cystic tumours of bone occur under one or other of these two headings, and the reader must refer to the preceding pages for an account of their origin.

(3) Simple cysts of bone must be exceptionally rare. They have, however, been described, but not in recent times, so that, until a modern microscopical examination has been made of such a tumour, we cannot feel sure that some new growth is not, after all, the cause of the cystic development.

(4) *Hydatids* may also, although very rarely, produce cystic cavities in bone. Several specimens are preserved in the museums of St. Thomas's and Guy's Hospitals. The bone becomes thin and expanded, and gives rise to the symptoms of a central cystic tumour. If this can be tapped, a diagnosis may be made by a microscopical and chemical examination of the fluid that is withdrawn. *See* Hydatids. But, from the histories of some of the recorded cases, it would appear that a fracture, occurring spontaneously and from some very trivial cause, is sometimes the first indication of the disease, and an operation, which has been undertaken for the resection of the fractured ends of the bone, has demonstrated the nature of the case by the escape of hydatids through the wound.

The treatment, that must be adopted for hydatids of bone, will vary with the amount of absorption and destruction of the osseous tissue. If a mere shell is all that is left of one of the longer bones, it may be necessary to amputate. But in the flat bones, and in

those cases of the longer bones in which such extensive destruction has not taken place, the hydatids and the cyst-wall may be carefully removed and scraped away, and the wound left to fill by granulation.

Pulsating Tumours of Bone.—It is probable that nearly all the pulsatile tumours of bone are central sarcomata, for an account of which see preceding pages. This question is also discussed under Osteo-Aneurism, where another condition, which must, however, be exceedingly rare, is described as producing pulsation in bone.

Carcinoma of Bone, as a primary disease, is almost unknown; in fact, it is believed by many to be impossible, as there are no epithelial tissues from which it could arise. Secondary growths are not uncommon, especially after scirrhus of the breast. In these cases, carcinoma may develop in the cancellous tissue of almost any of the bones, and may give rise to spontaneous fracture, or only be discovered *post mortem* in the bodies of the vertebræ.

Epithelioma rarely gives rise to secondary growths in bone, but often enough involves and partially destroys it by direct extension from the primary growth, as in the lip and tongue. Cancer of bone must therefore be looked for under *Sarcoma of Bone*. H. H. Clutton.

TYLOSIS.—Tylosis or tyloma is the name given to an hypertrophy of the epidermis. It consists of a horny mass, which may be of any size. It occurs chiefly on the palms and soles, but it may develop on any part of the body exposed to constant friction or pressure. Thus, on the hand it may be caused by gymnastic exercises, cricket, rowing, or any occupation calling for the excessive use of the part, and on the feet, at times, the unequal pressure of the shoe produces a thick and horny mass, causing great pain and inconvenience in walking.

Treatment.—Similar to that for hard corn. *See* Corns. Malcolm Morris.

TYMPANUM, Affections of the.—*See* Ear, Middle, Diseases of the.

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ULCERATION. — *Definition.*—A pathological process in which the affected tissues undergo softening and molecular death, and are cast off, partly in a minutely disintegrated, and partly in a liquid state forming a discharge or ichor. The molecular death, minute disintegration, and liquefaction of the affected tissues distinguish ulceration from sloughing and gangrene, in which the tissues die *en masse*, and, retaining their cohesion, are thrown off in the form of a slough or sphacelus. The above definition of ulceration chiefly applies to the process as it occurs in the skin and mucous membrane, or morbid growths in connection with these structures, and in the deeper tissues when exposed in an open wound.

Causes.—The process of ulceration is preceded by the infiltration of the affected part with morbid products, which may be either of inflammatory origin, or due to the less understood departure from normal nutrition that occurs in the formation of new growths. The causes of ulceration, therefore, looked at broadly, resolve themselves into the causes of inflammation and of new growths. These will be found fully discussed, so far as they are known, in the articles on these subjects. As regards ulcers of the integuments, however, with which this article is chiefly concerned, there are certain well-recognised causes, whether inflammatory or other, which will need special mention. These may be divided into the predisposing and the exciting.

1. The predisposing causes are — (*a*) *Certain constitutional conditions of the system*, such as exist in struma and syphilis, in some fevers, in the old, and in the badly nourished and cachectic generally. (*b*) *An alteration or defect in the circulation of blood through the part*: for example, a feeble circulation, such as often exists in the lower limbs of old people; a deficient supply of blood, such as occurs in scar-tissue or in consequence of atheromatous or other degeneration of arteries; and an excessive supply of blood, such as occurs in chronically congested and inflamed parts, and in limbs the subject of varicose veins. (*c*) *An alteration or defect in the nerve-supply of the part*, such as ensues upon division or other injury of a nerve-trunk, or disease or injury of the nerve-centres—a familiar example of this predisposing cause, when

combined with the exciting one of pressure, as seen in the bed-sores which occur after injuries of the cord in fractures of the spine. (*d*) *The infiltration of the tissue with certain morbid growths*, as lupus or epithelioma.

2. The exciting causes may often be very slight—indeed, so slight as to escape notice. They may be divided into—(*a*) *Direct injury of the part*, as from cuts and blows of all kinds, continued pressure, chafing or rubbing the part, the application of irritating ointments, or chemical agents as acids or alkalies, and burns and scalds. (*b*) *Irritation produced by the presence of foreign bodies in the part*, such as a thorn, bullet, &c., or of extravasated and putrid secretions, as urine, fæces, bile, synovial fluid, &c. (*c*) *Inoculation with certain specific poisons*, as those of soft chancre, hospital gangrene, &c. (*d*) *The presence of certain morbid growths*, as lupus, epithelioma, &c.

Pathology.—The process of ulceration may perhaps be best studied as it occurs in the skin, as the result of inflammation. The part is hot, red, and swollen. The cuticle in the centre of the inflamed spot softens, and is separated or rubbed off. The sore thus left gradually enlarges in depth and extent, by the melting away as it were of the inflamed tissues surrounding it; and an ulcer is produced, exuding an ichorous and sanious discharge. Under appropriate treatment, the surrounding inflammation now subsides, the destructive process ceases, the surface of the ulcer becomes covered with a number of minute red points called granulations, the discharge assumes the characters of healthy pus, and the ulcer gradually contracts and skins over from the margins, till finally the raw surface is covered, and a scar or cicatrix remains at the seat of the former wound.

The minute changes which occur in the course of the phenonema above described are as follows:—The tissues at the focus of inflammation, where stasis has already occurred, become infiltrated with serous exudation and leucocytes which have escaped from the blood-vessels. This leads to the increased proliferation of the cells of the cuticle, which are pushed forward before they have had time to assume their horny characters; and the cuticle thus softened readily separates, leaving the dermis raw and exposed. The infiltrated tissues are now softened and disintegrated by the pressure of the leucocytes, which, in their turn, also undergo degeneration, and are cast off along with the liquefied and minutely disintegrated tissues, forming a discharge or ichor. Thus the ulcer spreads in depth and extent. But if now the cause of the ulceration is removed, the circulation in the surrounding blood-vessels resumes its healthy characters, the abnormal exudation of serum and leucocytes ceases, and whilst the exposed surface of the infiltrated tissue still degenerates into pus, loops of delicate blood-vessels grow out from the neighbouring capillaries, permeate the deeper layers of the infiltrated tissues, and become surrounded with small round cells, formed either from the leucocytes or the cells of the original tissue. These cells are united by a homogeneous intercellular substance, and, together with the capillary loops, constitute the granulations, or more correctly speaking the granulation-tissue. Under healthy conditions, the growth of the granulation-tissue proceeds more rapidly than its superficial degeneration into pus, and so the ulcer is filled up. New epithelium is now formed from the old epithelium at the margin of the ulcer, and gradually spreads over the surface of the granulations till the ulcer is finally skinned over. Islets of epithelium are sometimes seen springing up on the surface of the granulations, unconnected with the epithelium of the margins; but it is probable that this only occurs when portions of the papillary layer, with cells of the rete Malpighii, have escaped the ulcerative destruction. The granulation-tissue is developed into fibrous tissue; this slowly contracts, obliterating many of the blood-vessels, and reducing the size of the ulcer; till at length a smooth, white, fibrous cicatrix, devoid of papillæ, sweat-ducts, hair-follicles, and lymphatics, and but poorly supplied with blood-vessels, alone remains to indicate the seat of the recent sore.

In the ulcerative process by which a portion of gangrenous tissue is separated from the living, the same pathological changes ensue, and are fully described under Gangrene.

When ulceration occurs in a morbid growth, as in epithelioma, the process of ulceration is essentially similar; the tissues are softened and disintegrated by the pressure of the infiltrating cells, and are cast off in the form of a discharge or ichor. In this case, however, the process is not the result of inflammation; the infiltrating cells are not leucocytes, but those of the morbid growth; and the process is one of continued destruction, showing, as a rule, no tendency towards repair.

The *treatment* of ulceration is given in detail under the various Ulcers.

W. J. Walsham.

ULCERS.—When the process of ulceration, whether the result of inflammation or of the breaking down of a morbid growth, involves the free surface of either the skin or mucous membrane, a loss of substance ensues, and the open sore thus left is called an ulcer. An ulcer, however, is not always produced by the process of ulceration alone, but frequently by the processes of ulceration and gangrene combined; as when a portion of skin from an injury or other cause dies, and the gangrenous piece is thrown off by the process of ulceration. The term ulcer, moreover, is often applied to any open granulating wound, left either as the result of an injury or of a surgical operation. The process by which an ulcer is produced has already been discussed under Ulceration. It now remains to describe the various forms of ulcers that are met with in surgical practice, with their diagnosis and treatment.

Varieties of Uleers.—The names by which ulcers are known have been derived either from the local condition of the ulcer itself or from its specific cause. Thus, when the process of ulceration, however produced, has ceased, and the surface of the sore has become covered by healthy granulations, the ulcer is said to be *healthy* or *healing*; when from any cause, as the too prolonged use of emollient applications, the granulations become pale and watery, it is spoken of as *œdematous* or *weak*; or if, from obstruction to the venous circulation in consequence of excessive contraction of the surrounding tissues (as, for example, in ulcers following burns), the granulations become protuberant and turgid, it is termed *exuberant* or *fungous*. When an ulcer is attended by signs of acute or sub-acute inflammation, it is called *inflammatory* or *inflamed*, the former term being generally applied to an ulcer having an acute inflammatory origin, and presenting signs of inflammation from the first; whilst the latter is used to indicate that the inflammation is a mere accidental condition, the result of local irritation, engrafted on any form of ulcer whatever its previous characters. If the inflammation is very acute, and the ulceration is accompanied by sloughing or by very rapid destruction of the tissues, the ulcer is spoken of as *sloughing* or *phagedænic*. If, on the other hand, the inflammation is of a chronic character, and the edges and surroundings of the ulcer become thickened and infiltrated with inflammatory products, it is termed *callous* or *indolent*. An ulcer, moreover, whatever its other characters, is often styled *varieose* when associated with or dependent upon a varicose condition of the veins of the leg; *eczematous* if surrounded with an eruption of eczema; *hæmorrhagic* when subject to bleeding; *painful*, *neuralgie*, or *irritable* when attended with excessive pain; and *eold* when occurring on the extremities of old people with a feeble circulation. Again, as the result of certain constitutional dyscrasiæ, ulcers present well-marked characters, and are named after the affections producing them. Such are the *gouty*, the *seorbutic*, the *strumous*, and the *syphilitie*; whilst ulcers due to the breaking down of morbid growths are denominated *lupoid*, *rodent*, *sareomatous*, *epitheliomatous*, *eareinomatous*, according to the nature of the growth preceding them.

The characters, diagnosis, and treatment of most of the above-mentioned ulcers will next be given in detail. In studying them, however, it should be borne in mind that, in actual practice, many minor shades of difference in the local condition of ulcers are constantly met with, and that it may be, therefore, difficult or sometimes impossible to assign to any given ulcer an exact place in a nosological table. The local characters of an ulcer, moreover, are subject to continual changes; an ulcer which at one time is callous may at another be inflamed, and at another sloughing. Further, ulcers of specific origin may have their characteristic features so obscured by inflammatory or other local complications, that it may not be until these have been subdued by rest and appropriate treatment that the diagnosis can be determined.

I. Ulcers whose Characters depend upon their Local Condition.—*The Healing, Healthy, or Simple Uleer.*—The situation, and at first the size and shape of this, must necessarily depend upon the original ulcer of which it is the healing form. The edges are neither raised nor depressed, inverted nor everted, but smooth and shelving, the healthy surrounding skin shading off into a thin bluish-white and glistening film, which extends over and is finally lost on the circumferential granulations. The base, unless the ulcer has been very deep, is level, or but slightly depressed below the surface of the surrounding parts, and is covered with small, pointed, florid granulations, not painful, and not readily bleeding when lightly touched. The discharge is small in quantity, and consists of laudable pus.

Treatment.—The ulcer, as the name implies, is a healing one, and the less it is meddled with the better. Rest, and a light dressing of wet lint to protect it from fric-

tion or other source of irritation, and the gentle cleansing of the surrounding skin at each dressing, are all that are required. When the wound is very large, healing may be hastened by skin-grafting. *See* GRAFTING. Dr. Hamilton of Aberdeen has recently proposed grafting with small portions of sponge, as a means of promoting the filling up of deep and healthy ulcers. The writer has seen this method tried in several instances at St. Bartholomew's Hospital, but the results were not satisfactory. The granulations grew into the sponge in the way described by Dr. Hamilton, but the wound did not skin over, and the portions of sponge, filled with granulations and consequently adherent to the wound, remained in this state for many months; and it was not until infinite trouble had been taken in picking out the sponge with forceps, from time to time, that the ulcers were at last induced to heal. Cicatrisation was certainly considerably delayed in these cases.

The Exuberant or Fungous Ulcer is characterised, as its name implies, by the overgrowth of its granulations, a condition due to obstructed venous return, and hence frequently met with after burns and other injuries followed by the undue contraction of the surrounding tissues. The granulations, which rise up above the surface and often considerably overhang the edges of the ulcer, are turgid and congested, of a dark red colour, redundant, and closely packed together; they readily bleed, and are covered with a purulent discharge. The edges and surrounding skin are healthy.

Treatment. — Solid nitrate of silver should be applied occasionally until the surface of the ulcer has been reduced to the level of the surrounding parts, and the sore then treated as described under *Healing Ulcer*.

The Œdematous or Weak Ulcer, like the exuberant or fungous variety, is characterised by the uprising of the granulations above the surface of the surrounding skin; but instead of being turgid and dark red from excess of venous blood, the granulations are pale, flabby, bulbous, semi-translucent, watery, and œdematous. They are soft, easily broken, and readily slough, and are covered with a profuse and watery discharge. The edges of the ulcer are smooth, flat, or slightly rounded, and the surrounding parts are healthy. This ulcer generally occurs in connection with scrofulous bones and joints; but any ulcer may become œdematous if healing is delayed, especially where poultices or other relaxing applications have been too long continued.

Treatment.—Equably applied pressure to the surface of the ulcer, painting the granulations with a strong solution of nitrate of silver, or destroying them by solid nitrate of silver and afterwards applying astringent lotions, is the local treatment generally required. It should be combined with the internal use of tonics, cod-liver oil, and a generous diet.

The Inflammatory Ulcer.—All ulcers due to inflammation might, during their formation, with propriety be styled inflammatory; but the term has been restricted to those in which inflammation of the surrounding integuments is the most marked phenomenon. Such ulcers generally depend upon some constitutional derangement, such as may be induced by gout, excessive drinking, &c., and are usually accompanied by more or less fever. Any ulcer, however, when subject to neglect and local irritation, may become inflamed, but these are more often, for the purpose of distinction, styled 'inflamed ulcers.' The inflammatory ulcer is commonly met with in the lower third of the leg, and is of an irregular shape. Its edges are ragged and shreddy, or abrupt and sharp-cut. Its base is very little depressed, void of granulations, dry, raw, and livid red, or bathed in a serous and often profuse and blood-stained discharge, mixed with débris of breaking-down tissues; or, when the inflammation is more intense, covered with a yellow slough. See *Sloughing Ulcer*. The surrounding skin is hot, red, painful, and œdematous. When inflammation attacks a previously granulating ulcer, the granulations become florid and swollen, and generally slough, whilst the ulcerative process, if the ulcer itself is previously healthy or stationary, is again set up.

Treatment.—Rest in the recumbent posture, with elevation of the limb, the removal of all sources of local irritation, the application of cold in the form of the lead and opium lotion, or, better, of warmth in the form of poultices and soothing fomentations, is the local treatment necessary; whilst the general health should be attended to by gentle aperients, restricted diet, and tonics.

The Sloughing Ulcer is perhaps most frequently met with in connection with venereal disease. *See* CHANCRE; SYPHILIS. But any ulcer when neglected or subjected to local irritation, especially in feeble and cachectic subjects, may become acutely inflamed and slough, spreading with great rapidity. The edges then appear undermined, inverted, of a dusky red colour, the

redness extending some distance in the skin around. The base is covered by an ash-grey pultaceous or black slough, and, if this is removed, appears red, raw, and void of granulations. The ulceration is generally attended with much local pain and sharp constitutional fever.

Treatment.—The patient should rest in the recumbent position, with the part elevated, and hot poultices or fomentations be applied till the sloughs have separated. Internally, opium should be freely administered, as it not only allays the pain, but appears to have a controlling action upon the inflammatory process. The bowels should be regulated, and the patient confined to a light but nourishing diet. When the ulcer is foul, disinfecting lotions or charcoal poultices must be freely used.

The Phagedænic Ulcer, owing to improved sanitation, better hospital management, and the more scientific treatment of wounds, is, like the sloughing ulcer, seldom seen at the present day except in connection with venereal disease. *See* PHAGEDÆNA; SYPHILIS. The two processes of sloughing and phagedæna are often present in the same ulcer, which is then spoken of as the sloughing phagedænic ulcer, or simply as sloughing phagedæna. Bad hygienic conditions generally, intemperance, want of sufficient and proper nourishment, uncleanliness and neglect of venereal sores, and possibly direct contagion from a phagedænic wound by means of infected dressings, sponges, &c., may be regarded as the chief predisposing and exciting causes of an ulcer becoming phagedænic. The pathological process is similar to that which occurs in other forms of ulceration, but the softening and disintegration of the tissues proceed with much greater rapidity, and are generally accompanied with severe constitutional disturbance. The edges of the ulcer when well established, present an irregular, eaten-out appearance; they are swollen, and of a dark purplish-red colour, fading off into a dusky red, and in places undermined and inverted. The surface is devoid of granulations, and is covered by a dark, blood-stained, ichorous discharge, often intermixed with sloughs. The ulcer spreads with fearful rapidity, and, if not arrested, an entire organ, as the penis or the whole of the vulva, may be destroyed, or a large vessel, as the femoral in the phagedænic bubo, may be opened, and the patient die of a sudden gush of hæmorrhage. On the arrest of the morbid process, the ulcer assumes the ordinary granulating appearance and heals in the usual way.

The *treatment* must be both local and constitutional. The ulcer should be thoroughly dried with pellets of cotton-wool or blotting paper, and the surface completely destroyed by fuming nitric acid. The patient should be placed under an anæsthetic, and the acid applied with a glass rod or brush. In less severe cases, boro-glyceride or carbolic acid in the form of a lotion may be sufficient. At St. Bartholomew's Hospital, the writer has seen the best results from the continuous use of the warm bath. In the case of phagedæna of the penis or vulva, the patient is placed sitting in the bath, the water being maintained at a uniform temperature for many hours. The constitutional treatment consists in the administration of full doses of opium, tonics such as iron and quinine, ammonia and bark, and stimulants in amounts varying according to the condition of the pulse, tongue, temperature, &c.; whilst thorough ventilation of the room is absolutely necessary.

The Irritable or Painful Ulcer.—This name is applied to a small, superficial, and very painful ulcer, commonly situated about the ankle, and occurring chiefly in women beyond the middle period of life. The pain, which is the chief characteristic, is sometimes excessive, even preventing sleep, and is thought by some to depend on the exposure of the peripheral terminations of nerve-fibres in the wound. The edges are perpendicular, irregular, somewhat raised, but vary considerably in appearance; the base is either sloughy or of a livid red, the granulations are shrunken or turgid and bleed when touched, whilst small blood-clots are sometimes dotted over the surface. The skin is, for some distance, congested and of a purplish red, and is often left discoloured and slightly thickened after the healing of the ulcer.

Treatment.—The general health should be improved by saline laxatives combined with quinine or iron, and the pain subdued and sleep obtained by small doses of opium. Locally, rest, elevation of the limb, and the application of the lead and opium lotion, will generally suffice. These means failing, the surface of the sore should be thoroughly cauterised with the solid nitrate of silver. In rare instances, it may be necessary to attempt the subcutaneous division of the nerves by passing a tenotome under the most painful spot, in the way described by Hilton.

The description of this ulcer does not apply to the painful fissure or ulcer of the rectum, which is fully treated of under FISSURE OF THE ANUS.

The Chronic, Callous, Indolent, or Atonic Ulcer.—This ulcer is seldom seen except among the labouring poor, in whom it is frequently found on the front and side of the lower third of the leg. It is very chronic and indolent in its course, often existing for many months or years. It is generally unattended with pain, and when small may cause but little inconvenience. It is usually oval or circular in shape, sometimes irregular, and of moderate dimensions; though not infrequently, when subject to long neglect, it extends round the greater part or the whole of the circumference of the leg. The edges of the ulcer are smooth, steep, and rounded, white, callous, and bloodless, quite insensible when touched, and often elevated above the surface. The base is smooth, and covered with a thin sanious or serous discharge, whilst granulations are either absent, or are minute, pale, flabby, and ill-formed. When of long duration, the ulcer is often adherent to the fascia beneath, or even to the periosteum or bone, and the surrounding parts are chronically congested, thickened, and infiltrated; the skin is scaly and pigmented, and the veins are not uncommonly varicose.

Treatment.—The key to the treatment of these ulcers lies in restoring the circulation through the callous walls, by promoting the absorption of the inflammatory products with which they are infiltrated. This is best done by pressure. Before commencing treatment by pressure, however, any transient attack of inflammation should be subdued, the ulcer, if foul, cleansed by carbolic lotions or linseed-meal poultices, and, under any circumstances, the callous edges macerated and softened by poultices or other emollient dressings. Where a week's rest in bed can be taken previously to beginning the pressure, the cure will be greatly expedited. Having brought the ulcer into a suitable condition, pressure may be applied either by a Martin's bandage, or by strapping after the method of Baynton.

A Martin's india-rubber bandage is best used without any dressing. It should be put on before the patient gets up in the morning, evenly and loosely, so that when the feet are placed on the ground it tightens from the natural swelling of the leg. It should be taken off at night, sponged with cold water, and hung up to dry, while the leg should be well cleansed, and a dressing of lint, soaked in a weak carbolic lotion and covered with oil silk, applied to the ulcer for the night. Ointment should not be used, as grease destroys the rubber of the bandage. Baynton's method consists in carefully and evenly strapping the limb with strips of adhesive plaster, beginning a little below and terminating two or three inches above the ulcer, and then applying a roller bandage from the foot to the knee. The strips of strapping should be perforated opposite the ulcers to allow of the escape of the discharge, and should not be disturbed for a week. The bandage should be re-applied daily, or at least every two days. The writer, when the ulcer is very deep, carefully packs it with very small pieces of lint soaked in black wash till the level of the skin is reached, before applying the strapping, and has found this modification very useful.

When the surface of the ulcer is only slightly depressed, good results have also been obtained by applying to its surface portions of sheet lead, cut to the size of the ulcer and secured to it by strapping and a bandage. Where the ulcer is very obstinate, the edges may have to be pared down, or incisions made through them to the deep fascia, or a blister applied over the ulcer, as recommended by Syme, before beginning the pressure treatment. When very large, and extending completely round the leg, the question of amputation will have to be considered. A callous ulcer, if converted into the healthy condition by the above means, may, when large, be treated by skin-grafting as already described. An ulcer subjected to constant movement, as when situated over the tendo Achillis, must be placed at rest by applying a suitable splint to the leg.

The Varicose Ulcer.—This term is applied to any ulcer dependent upon, or associated with, a varicose condition of the veins. Such ulcers are usually situated on the lower third of the leg, and are generally of the inflamed, irritable, or callous variety. The ulcer will therefore not require further description, and the pathology and treatment of the varicose condition of the veins will be referred to in the article on that subject.

The Eczematous Ulcer is one which is surrounded by an eczematous condition of the skin. The eczema may be either induced by the irritating discharge from the ulcer, or the ulcer may be due to the breaking down of the centre of the eczematous patch, which is then generally the result of a varicose condition of the veins. In either case, the ulcer itself may be of any of the forms already described.

II. Ulcers whose Characters depend upon their Specific Origin.—*The*

Gouty Ulcer.—The small superficial ulcerations of the skin, which are sometimes met with over gouty deposits, have been called by Sir James Paget gouty ulcers. They are characterised by their situation over evidently gouty parts, and by the discharge leaving, as it dries, a chalk-like deposit consisting of urate of soda.

The Scorbutic Ulcer.—Scurvy does not appear to be a specific cause of ulceration, but, when it occurs in a person the subject of an ulcer, the same semi-fibrous material is formed on the surface of the sore as gives rise to the spongy gums, petechiæ, and other local manifestations of the disease. The edges of the ulcer, whatever its previous condition, become swollen and tumid; whilst its surface assumes a characteristic appearance, being 'covered by a spongy, dark-coloured, strongly adherent, fetid crust, whose removal is attended with free bleeding, and is followed by a rapid reproduction of the same material.'

The *treatment* should first be directed to the correction of the constitutional condition, and the ulcer then dealt with according to its local condition.

Strumous Ulcers are most frequently met with in the neck in the course of the lymphatic glands, in connection with strumous bones and joints, on the cheeks and scalp, and occasionally in other situations. They are produced by the softening and breaking down of enlarged lymphatic glands, by the bursting of subcutaneous strumous abscesses, and by the ulceration of the pale, pink, low, flattened elevations, known as strumous tubercles. The ulcers are generally multiple, often confluent, frequently forming an irregular indolent sore in the course of chains of lymphatic glands. Their edges are irregular, of a pale pink or bluish colour, often thin and undermined, but occasionally thickened. Their base is covered by œdematous, pale, often protruding granulations, having a marked tendency to bleed when touched, and exuding a thin, yellowish-green, scanty discharge. Enlarged glands and the cicatrices of former ulcers are frequently present in their near neighbourhood, or, in the case of ulceration of the neck, on the opposite side. The presence of these cicatrices is very diagnostic of this variety of ulcer. They are usually of a pale pink colour, or white when less recent, and slightly raised above the surface of the surrounding skin, which is puckered and variously drawn in towards them, forming cracks and crannies in which particles of dirt are apt to lodge. The cicatrices sometimes assume the form of irregularly shaped bands, giving the part a peculiar trellis-like appearance. Their appearance in connection with strumous bones and joints is described under those diseases.

Treatment.—Cod-liver oil, or maltine, syrup of the phosphate or iodide of iron in drachm doses, sulphide of calcium in doses varying from one-sixth to half a grain according to the age of the patient, together with an unstimulating diet and residence at the seaside, are amongst the constitutional measures which should be adopted. Locally, red oxide of mercury ointment, or lactate of lead made by pouring Goulard water into milk, will often be of service; but, if intractable, the edges and surface of the sore should be destroyed by nitrate of silver, or pared away, and the base scraped with a Volkmann's spoon. The cicatrices may sometimes be dispersed by repeated applications of blistering fluid, or, if this fails, it may be of advantage to excise them.

Syphilitic Ulcers.—Two forms of ulcer occurring in the course of constitutional syphilis are here described, the superficial and the deep. The primary syphilitic ulcer is described under Chancre.

A. *The superficial ulcers* are generally due to syphilitic ecthyma or rupia, or to the breaking down of syphilitic tubercles, and have often associated with them patches of these eruptions on various parts of the body. Any superficial ulcer, moreover, occurring in the course of syphilis, may take on the syphilitic characters to be immediately described. They are generally multiple, and are more common on the trunk than on the extremities. They are usually circular, or crescentic, or of a horseshoe shape, often spreading by their convex margin whilst healing on their concave. Their edges are sharp-cut, neither inverted nor everted, raised nor depressed, and unattended by induration. Their bases are but slightly depressed, of a dark red colour, and often covered by a yellow slough or an ecthymatous or rupial scab. The surrounding skin is healthy, though an areola of dusky redness may immediately encircle them. On healing, they leave a bluish-white, semi-translucent, slightly depressed cicatrix, which is apt to break down on slight provocation. Several of these ulcers frequently coalesce, giving rise to a serpiginous or annular form of ulceration, which is very characteristic of syphilis.

B. *The deep ulcers* are nearly always due to the breaking down of gummata. They may occur in any part of the body,

but are most frequently met with in the lower extremities, in the neighbourhood of the large joints, and about the palate and fauces. They begin as deep-seated swellings, which at first are hard and painless, and unattended with signs of inflammation; then central softening occurs, the skin over them becomes inflamed and gives way, a slough separates, and the ulcers are produced. The ulcers are circular or oval in shape, of moderate dimensions, surrounded by a dusky red areola, but by only slight induration; they are generally painless; their edges are sharp-cut, steep, often slightly overhanging or scooped out, and of a dull red colour. The centre of the ulcer is at first occupied by a yellow slough, intermixed with shreds of the breaking-down tissues. On its separation, the base appears considerably below the surrounding skin, but rapidly fills up with granulations under appropriate treatment, the resulting cicatrix remaining slightly depressed, of a smooth, polished, and white appearance, while the skin immediately around is more or less pigmented. Two or more ulcers are frequently present at the same time, one perhaps open and discharging, another in a stage less advanced, whilst there may be several gummata around not yet broken down; and cicatrices of former ulcers are often to be found in the near neighbourhood, or perhaps in a different part of the body.

Treatment. — Iodide of potassium in full doses, combined with quinine, bark, &c., should be administered internally; whilst locally a poultice should be applied till the scab or slough has separated; and afterwards, the red oxide of mercury ointment, or the black wash, or iodoform powder should be used. Where the gummata are not broken down they should on no account be opened, as, even after softening has occurred, they may completely clear up under the influence of the iodide. Inflammation, if present, should be subdued previously to beginning the specific treatment. *See* Syphilis.

Lupoid Ulcers are such as are produced by the softening and breaking down of lupoid tubercles. Lupoid ulcers are most commonly met with on the face, especially about the alæ of the nose. When first formed, their characters, with regard to shape, size, and number, will depend upon those of the lupoid tubercles that precede them. But as the ulcers extend they become confluent, and, spreading superficially, may destroy large portions of skin. They sometimes extend deeply as well, eroding the cartilages and even the bones, and producing great deformity. The edges of the ulcer are slightly elevated, irregular, eaten out or sharp-cut, and neither inverted nor everted; the base is slightly depressed and raw, granulations being either absent or spongy and prominent, or it may be covered by a scab of hardened secretion. Tubercles that have not yet undergone softening may be seen in the skin around, whilst depressed white cicatrices, produced by the healing of former ulcers, are often present in the near neighbourhood.

Diagnosis.—Lupoid ulcers have to be distinguished from impetigo, from tertiary syphilitic, strumous, and rodent ulcers, and from epithelioma. When the lupoid ulcer is covered with scabs, it may bear a resemblance to impetigo; but the latter affection may be distinguished by its beginning as a pustular eruption, by the absence of tubercles around, by its evanescent character, by the thick yellow characteristic crusts, and by the absence, on removing them, of the ulcerated and spongy surface beneath, as seen in lupus. From ulcers occurring in the course of tubercular syphilides (the so-called syphilitic lupus), it is often very difficult to make a diagnosis. The age at which the disease began, its history and duration, the presence or absence of concomitant signs of syphilis, and the effect of antisyphilitic remedies will help in the determination of the point. The age of the patient is an important factor in distinguishing lupus from rodent ulcer and epithelioma, as both of these latter affections are very rare before fifty. Both may further be distinguished from lupus by the absence of tubercles around, by being single, and by showing generally no tendency to contract and heal. In epithelioma, moreover, the edges are indurated and everted, and the glands are enlarged at an early date of the disease.

Treatment.—The lupous tissue should be thoroughly destroyed either by scraping the surface of the ulcer with a Volkmann's or Morris's spoon till healthy tissue is reached, or by cauterising the parts with the actual or galvanic cautery. Internally, cod-liver oil and arsenic will be found the most useful remedies. *See* Lupus.

Rodent Ulcer, although now almost universally regarded as a form of carcinoma, is here described separately, as, whatever its pathological relations, its clinical characters differ in many marked respects from those of ordinary carcinoma. Thus it is much slower in its growth, in some cases having been known to be in progress for

upwards of thirty years. It does not become disseminated, nor, like epithelioma, affect the neighbouring lymphatic glands; nor does it return after complete removal. The patients often enjoy excellent general health throughout its course, attain old age, and appear, except for its local ravages, to be none the worse for its presence. Still, like carcinoma, it is progressively destructive, spreading by infiltration of the surrounding tissues, and sparing neither cartilage, bone, nor other tissue in its neighbourhood; and finally, like it, destroying life. *See* CARCINOMA.

Symptoms.—Rodent ulcer is a disease of advanced life, seldom occurring under the age of fifty. Its favourite seat is the face, especially about the internal and external canthus of the eyelids and the alæ of the nose, and the scalp. It generally begins as a warty elevation of the skin, of a reddish-brown colour. This, after undergoing several desquamations, finally breaks down into an ulcer. The ulcer is generally single; its edges are irregular, sinuous, a little raised, and but very slightly if at all indurated. The skin around is supple and healthy; the base is slightly depressed, void of granulations, glazed, sometimes furrowed, and of a whitish or pale pink colour; the discharge is scanty and generally thin, though sometimes, especially when astringent lotions have been applied, it may harden, forming variously coloured crusts. Imperfect attempts at cicatrisation are sometimes seen, but no contraction of the part follows, and the ulceration soon again proceeds. It may continue superficial, but spread widely, or it may extend deeply, eating away and destroying everything—muscles, cartilages, bones—in its vicinity, and producing horrible deformity. Thus, a deep, gaping chasm, sometimes involving a part or the whole of one side of the face, may be left; the globe of the eye, perhaps, being destroyed, and the nasal cavities laid open to view. Or the cranium may be perforated, and the dura mater or even the brain exposed.

Diagnosis.—Rodent ulcer may sometimes have to be distinguished from epithelioma, lupus, or syphilis. From epithelioma it may be diagnosed by the absence of induration around, the non-involvement of the lymphatic glands, and its slower growth; but often in their early stages it may be impossible to distinguish these affections. From lupus it may be known by the absence of tubercles around and of cicatricial scarring, and by its beginning in the old, whereas lupus begins in the young. From syphilis it may be known by the rate of growth, the absence of concomitant signs of the latter affection, and the effect of remedies.

Pathology.—When the edges of the ulcer are examined microscopically, they are found to be infiltrated with a new growth; but the ulceration follows so quickly on the infiltration that, except just beyond the edge of the ulcer, the tissues are healthy. The cells are smaller than those of epithelioma, but are contained in alveolar spaces like those of carcinoma. Cell-nests, but ill-formed and not traceable to ingrowths of the epithelium, are said to have been here and there discovered. The manner in which the growth begins has not for certainty been ascertained, but it appears, from recent researches, to start as a proliferation of the sweat-glands or hair-follicles.

Treatment.—Early and wide extirpation by means of the knife should always be undertaken, and if any doubt exists as to whether the whole of the disease has been removed, the parts should be further destroyed by caustic or by the actual or galvanic cautery. When extensive ravages have occurred, much may still often be accomplished by the knife; and although a fearful chasm may be left—the globe of the eye perhaps extirpated, and the greater part of one side of the face cut away—if the whole of the disease has been removed, the parts may then, to a great extent, granulate up, and the deformity be in some measure obviated by the patient wearing a vulcanite mask, shaped to the lost features and coloured to the complexion.

Epitheliomatous Ulcer.—The general pathology of epithelioma is given under CARCINOMA. The epithelial ulcer may begin as a crack or fissure at the junction of the skin and mucous membrane, or as a wart or pimple on the skin, or it may occur in the seat of an old scar, or in an ulcer that has continued open and discharging for a long period. It is characterised by its irregular, sinuous, raised, everted, and indurated edges; by its indurated base, which is generally raised, and covered with a scab or with warty or proliferating and cauliflower-like granulations; by its thin, ichorous, and sometimes sanious discharge; by the evident infiltration of the surrounding tissues with the new growth; and, after it has existed some time, by the enlargement of the neighbouring lymphatic glands. As the ulcer progresses it gradually invades the surrounding tissues, destroying fat, muscle, cartilage, and bone; the enlarged lymphatic glands soften and break down,

the skin over them gives way, and a secondary ulcer, with characters similar to those of the primary, is produced. Remoter glands may next become affected, but the disease, unlike the other forms of carcinoma, does not, as a rule, become disseminated through internal organs.

Diagnosis.—The induration of the edges and base of the ulcer, the advanced age of the patient, the rapid growth of the disease, the warty or proliferating character of the granulations, the evident presence of a new growth, and the infiltration of the lymphatic glands, are signs which will serve to distinguish an epitheliomatous ulcer from the other forms above described. A microscopical examination of a scraping of the growth will often assist in the diagnosis.

Treatment.—Free and early extirpation is the only treatment of any avail, and should always be resorted to when there is a fair probability of getting away the whole of the disease. A moderate enlargement of the neighbouring lymphatic glands does not, in the writer's opinion, contra-indicate the operation, and any such glands should, if consistent with safety, always be removed at the same time.

W. J. Walsham.

ULNA, Dislocation of the.—The upper extremity of this bone has, in very rare cases, been found dislocated backwards, whilst the radius retained its normal position. The writer has once had an opportunity of examining this dislocation. The forearm was semiflexed and strongly pronated, and the olecranon formed an unmistakable prominence behind the elbow. The hand inclined to the ulnar side, and the measurement from the internal condyle to the pisiform bone was half an inch shorter than the same measurement on the other arm. Movements caused great pain, but the head of the radius could be felt in its normal relation to the humerus, on attempting supination. This dislocation is sometimes associated with partial displacement of the radius forwards. Under chloroform, extension from the ulnar side is not likely to fail; but in a case reported by Waterman, straightening of the arm was found necessary, whilst, in one related by Pirrie, sudden flexion combined with pressure on the olecranon proved successful after extension by assistants. (Dislocations at the lower radio-ulnar joint, which some authors describe as dislocations of the lower end of the ulna, will be found under Wrist).

R. Clement Lucas.

ULNA, Fractures of the.—The *olecranon* may be fractured by falls on the elbow—its most common cause; by direct violence, as by a blow; and, as recorded instances appear to show, occasionally by the action of the triceps. The size of the portion detached varies from a thin plate to the whole of the process. The fragment is drawn up at the back of the joint, sometimes slightly, sometimes for an inch and a half, so that an interval—much increased when the arm is bent—can be readily felt; it can be moved from side to side, and the power of extending the forearm is much impaired. The joint is more or less distended with fluid. Union is generally ligamentous.

Treatment.—The arm must be placed in the extended position on a splint—best applied to the anterior aspect—and the inflammatory swelling usually present must be reduced by rest, position, and cold lotion. As soon as practicable, an attempt should be made to bring the fragment down towards the remainder of the bone. This may be done, either by a figure-of-eight bandage passing above the fragment and round the forearm; or, by placing two pieces of narrow bandage lengthwise, one on the inner and one on the outer side of the joint, crossing them with two or three turns of bandage above and below the elbow, and then tying the upper and the lower ends of each together. These methods, however, are not very efficient, and they, moreover, tend to produce swelling of the joint by constriction. A better plan is to use a loop of narrow elastic bandage, the middle of which arches over the fragment, while its two ends are fastened, one to the inner and the other to the outer border of the splint, at a convenient distance below the elbow, to secure the requisite amount of downward tension; or the fragments may be wired together, as recommended by Sir J. Lister. This operation, however, although it is no doubt free from any considerable risk, is, in the opinion of the great majority of surgeons, not warranted by the necessities of the case, since short ligamentous union, attended with only very slight impairment of the functions of the limb, can be obtained without operative interference. Some surgeons trust entirely to the natural contraction of healing, and keep the elbow bent and the forearm in a sling, with very good results.

Fracture of the *coronoid process*, though a very rare accident, and one which has often been diagnosed when it did not exist, has several times been verified on dissection. Generally, it is produced by falls on the

hand, and is associated with dislocation of the forearm backwards. The injury may be recognised by the fact that dislocation is reduced by slight force, but recurs when extension ceases. Possibly, the detached pieces may be felt in front of the elbow, and crepitus may be present. The brachialis anticus, however, is attached to the base of the process, so as to overlap it towards its apex in such a way that wide separation, unless the muscle itself is torn away, can hardly occur.

Treatment.—The forearm should be flexed upon the chest and confined in a sling. For the management of relapsing dislocation of the elbow, *see* ELBOW-JOINT, Dislocations of the.

Fracture of the *shaft of the ulna* alone is rare, and is always the result of direct violence. The upper third is so strong that it seldom gives way, but the middle and lower portions are sometimes broken in falls over some projecting object or by a blow. There is usually but little displacement; the injury, however, is plainly indicated by mobility, detected by fixing the upper, and pressing the lower fragment towards the radius, or by moving the pieces on each other, by crepitus, and by irregularity of the bone when its subcutaneous ridge is traced down.

Treatment.—As the bone is well supported by the radius, and displacement is usually slight, it is sufficient to apply a pair of straight splints, one on the dorsal and one on the palmar aspect of the limb, and to place the forearm in a sling in the semiprone position; or gutta-percha or leather splints moulded on the limb, or a light case of plaster of Paris may be used, instead of the straight splints. But should there be any tendency of the lower fragment to start towards the radius, it is better to use the straight splints, with the addition of a narrow pad carefully adjusted over the space between the bones; and the forearm should be placed in a position of supination. The splints may be discontinued at the end of the month; the arm, however, being kept a few days longer in a sling. Passive movement for supination and pronation should at the same time be carefully employed.

HOWARD MARSH.

ULNAR ARTERY.—I. *In the Forearm.*—The artery commences one inch below the elbow—i.e. opposite the neck of the radius—passing obliquely inwards for a short distance, it then runs down the forearm parallel to a line drawn from the front of the internal condyle of the humerus to the outer side of the pisiform bone.

In the *upper* half the artery passes between the superficial and deep layers of muscles; it has superficial to it skin, superficial fascia with the internal cutaneous nerve and ulnar veins, deep fascia, pronator radii teres, flexor carpi radialis, palmaris longus and flexor sublimis muscles; the median nerve crosses it three-quarters of an inch below its commencement, passing from within outwards. The artery rests on the flexor profundus digitorum. In the *lower* half of the forearm the artery is covered only by cutaneous structures, and it rests on the same muscle; it has the flexor carpi ulnaris tendon to its inner side, serving as a guide, and the flexor sublimis externally; the ulnar nerve lies on its inner side.

LIGATION.—1. In the middle of the forearm the artery is reached by an incision, two inches long, in the guiding line of the artery. Cut through the cutaneous structures; in opening the deep fascia, recognise the outer tendinous edge of the flexor carpi ulnaris, enter between the sublimis externally and this tendon internally, and find the ulnar nerve or artery. If between the ulnaris tendon internally and the sublimis externally the nerve is seen, the artery, with its veins, will be to its radial side.

2. In the lower third the artery is exposed by an incision commencing in the guiding line two inches above the wrist, and ending half an inch above the pisiform bone. The outer edge of the ulnar tendon again serves as a guide, especially after the cutaneous incision is made. It is drawn inwards, when the artery is found lying beneath a process of the deep fascia, with the ulnar nerve to its inside, the flexor sublimis to its outside, and, behind, the flexor profundus digitorum.

II. *In the Hand.*—The ulnar artery passes from the outer side of the pisiform bone across the palm of the hand, just below the crease of the thumb muscles—the line of life—forming with the superficialis volæ from the radial, the superficial palmar arch. When the ulnar artery is clear of the pisiform bone, it sends down a deep branch to complete the deep palmar arch by joining with the radial trunk. The superficial palmar arch sends downwards digital arteries towards the clefts between the fingers, where, opposite the heads of the metacarpal bones, each vessel divides to supply the fingers, passing along their lateral aspects. The arch lies beneath the palmar fascia, and upon the median nerve and the sublimis tendons. The deep arch lies upon the bases of the metacarpal bones.

JAMES CANTLIE.

UMBILICAL FISTULA may result from one of three causes, the first two of which are congenital. (1) It may result from non-closure of the urachus, or (2) from continued patency of the omphalo-mesenteric duct. (3) It may arise from the opening of an abscess in some part of the abdominal cavity.

1. The urachus, which forms in early fœtal life a tubular communication between the bladder and the allantoid vesicle, and should become closed long before birth, remains occasionally patent, and it then gives passage to small quantities of urine, and has been known to remain unclosed until late in life. Besides the flow of urine from within, materials from without sometimes pass into the channel, and are then liable to become nuclei, around which concretions and deposits from the urine will collect and give rise to considerable trouble and inconvenience. In general, the permanence of such opening is marked by the occasional and inconstant issue of urine, and as a consequence of this, some eczematous eruption may be found at and around the navel. Spontaneous closure may take place after birth, but when it does not, and when the inconvenience and suffering is sufficient to render operative measures necessary for the closure of the opening, a light touch of the actual (or Paquelin's) cautery, or of a galvano-caustic wire, followed by careful strapping together of the granulating surfaces, is all that is requisite to effect their union. In some instances a mass of granulations is seen to arise from the umbilicus and to constitute a tumour, which attains in some instances a length of nearly an inch; and in the centre of this there may often be seen a small channel, from which issues a frequent discharge of fluid, having the characters of urine. The granulations are merely a result of irritation, and are directly due to the permanence of this condition. A ligature, tied firmly round its base, will strangulate the tumour, and the treatment above recommended will close the canal if it still persists.

2. Although very rarely, instances are occasionally met with, in which there remains a congenital communication between the umbilicus and some part of the intestinal tube by means of the omphalo-mesenteric duct, which, though often obliterated, can not infrequently be detected at post-mortem examinations as a diverticulum running upwards from the lower part of the ileum, and attached at the umbilicus. Through this canal, when patent, discharges having a fæcal odour will exude, and sometimes even small quantities of the ingesta can be detected in the fluid that issues. The treatment recommended above may be applied in such cases, or the edges may be pared and brought together by stitches.

3. By far the most usual cause, however, of this form of fistula, occurs in children with a tendency to a tubercular diathesis, and is due to the opening of an abscess at the umbilicus, which, in most instances, is the result of suppuration in the glands of the mesentery, either from breaking down of tubercular deposits, or secondary to some inflammation or ulceration of the intestines. This form, therefore, is never of congenital origin, and the discharge is more distinctly purulent, and when mixed, as it not infrequently is, with fæcal matter, points to the existence of a communication with the cavity of the intestine. There would seem to be a natural tendency for such accumulations of matter to make their way towards, and to present at, the umbilicus, although no good anatomical reason can be given for their taking this direction. When once the abscess has burst, the sinus which follows is lined with healthy granulations, and can be traced for some distance into the abdomen by means of a probe, and the external aperture is occasionally large enough to admit the tip of the little finger. The presence of bile in the discharges may indicate a connection with the liver or its ducts, but no such communication has ever been demonstrated by dissection. These fistulæ are very difficult to close; sometimes they will heal spontaneously after a considerable lapse of time, if the patient is kept quiet in bed; in other instances they will heal after adoption of some such methods as are mentioned above; but it is often necessary that the sinus should be laid open, and this is best done by passing down a probe-pointed bistoury as far as is deemed safe and cutting outwards, the wound being dressed antiseptically, and allowed to heal from its deepest part. See *Fæcal Fistula*, under FÆCAL ABSCESS.

JOHN H. MORGAN.

UMBILICAL HERNIA. — Ruptures at the umbilical cicatrix are of three kinds: 1. The congenital. 2. The infantile. 3. The adult form.

1. *The congenital.* These herniæ are very rare, and exist at the time of birth. They are due to an arrest of fœtal development, whereby the abdominal cavity remains imperfectly closed in the region of the umbilicus. Some of these herniæ are

of enormous size, and contain nearly all the abdominal viscera. They occur in monsters, and are associated with other deformities not consistent with life. As a rule, the protrusion is small, and is in the substance of the cord. The tissues of the cord are stretched over the sac, with which these herniæ are always provided, and the umbilical vessels are separated by it. The rupture appears as a rounded or conical swelling at the point of attachment of the umbilical cord to the abdomen. The coverings of the hernia may be so thin that the contained gut can be seen through them. Or the coverings may be absent, or may become ruptured soon after birth, and allow the viscera to escape. The contents are usually small intestine, and very often the cæcum. In some instances, the hernia and its contents have unwittingly been cut across in dividing the cord at birth. In many instances the hernia has undergone spontaneous cure. In any case the rupture should be reduced, and retained by broad strips of strapping passed round the abdomen.

2. The infantile form is very common. It depends upon yielding of an imperfectly consolidated umbilical cicatrix, and is most frequently met with during the first year of life. The swelling is usually small, and gives no trouble. So far as the writer is aware, it is never the seat of strangulation. Beyond certain moderate limits the hernia shows no tendency to increase. If left alone these ruptures will, in nearly every instance, undergo spontaneous cure. If any treatment be required, the hernia should be reduced, and the edges of the hernial orifice carefully held together by the forefinger and thumb. The margins of the opening should then be maintained in this position by means of strips of strapping passed across the abdomen. There is a form of treatment which is to be condemned, if on no other ground than that it prevents the cure of the rupture, and tends to perpetuate it indefinitely. It takes the form of an elastic belt, to the inner aspect of which a small button or nodule is affixed. This button is supposed to fit into the hernial orifice, and while it occupies that position it merely keeps the abnormal orifice patent, and prevents its closure. Fortunately, the button soon slips out of place, and no harm is done, except such as may be occasioned by the wearing of a tight abdominal band.

3. The adult form. The umbilical hernia of adults may—as a rare circumstance—have persisted from infancy. The great majority, however, are newly formed in adult life. This hernia is more common in women that in men, is most common in those who are obese and have large and pendulous abdomens, and especially in women who have borne many children. The average size of the rupture is about that of the closed fist. It may, however, attain large dimensions. As it increases in size it becomes pendulous, and may in time reach the groin. The hernia is always provided with a sac. The tumour is often irregularly lobulated, and its coverings are frequently very thin. The contents of the protrusion are most usually the great omentum, the transverse colon, the small intestine. It may contain the stomach, and even the cæcum. It often presents what is known as an omental sac.

This hernia is often irreducible in whole or in part. It is sometimes inflamed; it is but rarely strangulated; it is peculiarly prone to become obstructed or incarcerated. When reducible, it should be retained by a suitable abdominal belt. The introduction of a small pad of cork in the front of these belts is objectionable. The pad occupies the hernial orifice, and tends to maintain, if not to increase, its dimensions. When irreducible, the rupture should be protected and supported by a proper belt, the precise arrangement of which will vary according to the size and outline of the rupture, and the condition of the abdominal walls.

When the hernia is strangulated, it may often be reduced by taxis, the pressure being applied in a direction directly backwards. When herniotomy is required, a vertical incision of about two inches in length is made in the middle line at the upper part of the tumour. One half of this incision should fall upon the tumour, and the other half upon the abdominal parietes. The risk of cutting into the sac is much diminished by making the incision from below upwards, thus commencing it upon the tumour. The stricture will be at the opening in the parietes; and it should be divided by cutting directly upwards in the middle line. When possible, the rupture should be reduced without opening the sac. After the hernia has been reduced, the edges of the hernial orifice should be carefully brought together by several points of catgut suture. The sac may then be excised close to the hernial aperture, and its cut edges neatly brought together by sutures which maintain its serous surfaces in contact. When the hernial orifice is very large, it may be necessary to use harelippins to effect a closure. In such a case the pins should be removed at the end of forty-eight hours. FREDERICK TREVES.

UMBILICUS or NAVEL.—The umbilicus is more frequently spoken of as an anatomical point, than as the seat of any peculiar diseases. It is situate in the middle line of the abdomen, a little below midway between the ensiform cartilage and the symphysis pubis, and marks the point of separation of the two recti, which admits the entrance of the contents of the umbilical cord, and forms the point of their attachment subsequently to fœtal life. These are the umbilical arteries and vein, and the urachus, which are enclosed, within the abdomen, in a fold of the parietal peritoneum. It corresponds in situation to the body of the third lumbar vertebra, and the spot at which the aorta is most easily compressed is about an inch below and a little to the left of the umbilicus. It is below the umbilicus that the usual incision in the median line commences in laparotomy for intestinal obstruction, or in operations for the removal of tumours of the uterus or ovaries; and the cases are rare in which it needs to be carried above this spot, but when this has become necessary, the abdominal walls should be divided with blunt-pointed scissors, and the incision be carried round, but never through, the umbilicus. Other operations, either for removal of tumours of abdominal organs, or for other purposes, may commence above the umbilicus, but the same rule must apply in extending them downwards. In a healthy state, the rudiments of the cord dwindle after birth, and a firm cicatrix is formed; but it sometimes happens that when a ligature has been placed on the cord, the portion nearest to the infant does not wither, and is converted into a granulating mass which requires a fresh ligature to be placed round its base, or the application of a piece of solid nitrate of silver, before it dwindles to its normal condition. *See* Umbilical Fistula.

Hæmorrhage sometimes occurs in newly-born infants from careless ligature of the cord, or from the ligatured portion being torn off before the vessels are properly closed. This is seldom of much consequence, and is to be arrested by replacing the ligature. But a much more formidable hæmorrhage, or rather a constant oozing of blood from the granulating surface of the navel, sometimes takes place soon after birth, and this is either due to the hæmorrhagic diathesis, or it is found to be associated with a congenital malformation of the cystic or hepatic biliary ducts, or to the absence of a gall-bladder. Such bleeding is not restrained by styptics or even by ligature, owing to the absence of any coagulating power in the blood; and although when associated with these deformities, there is invariably a fatal termination, yet it is necessary to check the hæmorrhage, which can only be done by passing harelippins through the integuments, and constricting the parts with a piece of silk tied round their ends. The condition often occurs in several children of the same parents. Fatal cases of pyæmia in infants, with multiple abscesses and destructive inflammation of various joints, have sometimes been ascribed to inflammation of the umbilical vein.

In very stout persons a deep transverse depression often exists, running across the abdomen and completely obscuring the navel from view. This furrow frequently becomes the seat of a troublesome eczematous eruption, which goes on to ulceration if the affection is not speedily relieved. The variety is known as eczema intertrigo, and is one which is especially liable to affect fat subjects. It arises from decomposing secretions (sweat, &c.), being confined in moist and warm situations, and is characterised by an angry erythematous blush, associated with sodden epidermis and fetid exudation. The treatment consists in thoroughly separating the parts and cleansing with oatmeal and warm water, after which rags soaked in an astringent lead lotion should be applied for some hours, and finally a desiccant powder should be dusted on and some soft absorbent material employed to separate the parts. A saline aperient should be given at the same time.

Other forms of ulceration may affect this region, particularly those occurring in the third stage of syphilis, and a Hunterian chancre may sometimes be detected. Psoriasis, whether simple or syphilitic, causes great irritation, when by reason of folds of fat there is accumulation of acid secretion on surfaces denuded of epithelium. So too scabies finds a convenient nidus in this situation, and will often give rise to the greatest discomfort. Epithelial cancer is seen sometimes to arise idiopathically from the umbilicus, and commences as a superficial ulcer, resembling an excoriation and dipping into the pit of the navel or occupying the summit of the prominent button at the bottom.

Umbilical hernia or ruptured navel occurs in infants and is very common. The contained viscus, which is usually part of the small intestine, but which may be the stomach, omentum, large intestine, or bladder, pushes forward a portion of the parietal

peritoneum through the lax tissues which surround the umbilical vessels at their attachment in the linea alba. The coverings are therefore very thin and the diagnostic symptoms are those of hernia generally (*see* Hernia). A small round tumour is present, easily reduced by the pressure of the fingers, and the sharp tendinous edges of the aperture can then be felt. It seldom becomes large, except when conjoined, as it sometimes may be, with a ventral hernia, produced through non-closure of the recti above or below the navel. In all cases it has a tendency to natural cure, so much so that umbilical hernia is almost unknown in youth, and the only remedy which the surgeon is called upon to prescribe is a flat pad of cork, or of metal, covered with wash-leather, and secured by strapping or by an elastic band which laces behind. Some surgeons have, however, thought fit to operate in these cases.

The form of umbilical hernia which occurs in adult life is a protrusion which arises at one side of the navel proper, generally in the middle line above it, and is found in elderly persons, more commonly in stout females. The viscus, whether intestine or omentum, pushes forward the fibrous structures which are relaxed in consequence either of frequent pregnancies or of general fatty degeneration. It has a tendency to increase in size, and is not unfrequently irreducible, owing to the formation of adhesions. When this form of hernia becomes the seat of strangulation operative interference is not always called for, as the symptoms will often subside after the active use of enemata, &c.; but when it becomes imperative to use the knife the issue is frequently unfavourable, on account of the general unhealthy condition of such patients. A carefully constructed truss must be constantly worn. John H. Morgan.

UNREDUCED DISLOCATIONS. *See* Dislocations.

UNUNITED FRACTURE. — True ununited fractures are rare; but some delay in the process of union, especially where the fracture has been inefficiently treated, is not uncommonly met with. No hard and fast line can be drawn between the two classes of cases: the union of such a bone as the femur may be delayed many months—in one recorded case for as many as twenty-two—and yet eventually take place without operative treatment. It is difficult, therefore, to say at what exact time a case of delayed union becomes one of ununited fracture. Whatever induces delay in the union of a fracture may also, if the same conditions continue to exist, lead to permanent non-union.

The great majority of cases of ununited fracture depend on some *local* cause. The fracture has been badly set, the fragments have never been in good apposition, with perhaps some foreign body, some piece of muscle or other soft tissue, between them: or, originally together, the splints over them have been too tightly or too loosely applied, producing in the former case obstruction to the circulation and consequent delay in the deposit of reparative material, allowing in the latter harmful mobility. An over-anxious surgeon, who is perpetually meddling with a fracture, may get delay or even non-union for his pains; and restlessness and intractability, on the part of the patient, will predispose to the same result. Injury to the nutrient artery, or to the main vein of a limb, with resulting phlebitis and thrombosis, may be mentioned amongst the local causes of delayed and non-union, as also may disease of the fractured bone itself. Of this, necrosis is the most common example, and it is nearly always in cases of compound fracture that it is met with, either following comminution of the bone or detachment of its periosteum. In very rare instances, small detached portions of bone, embedded in the callus, necrose at a later period and cause disunion. In the London museums are five preparations showing non-union from mollities ossium, one from atrophy, one from fragilitas ossium, and one, in a lion's bone, from rickets. Cases of non-union are mentioned by Norris, in which bones affected with chronic abscess, hydatid cyst, and nodes, have given way at the seat of disease. The too early removal of splints, especially in oblique fractures of the lower extremity, where the weight of the body is thus prematurely brought to bear on imperfectly ossified callus, may lead to the absorption of that already laid down, or prevent its further development. Sometimes, a congenital ununited fracture is met with.

Most *constitutional* causes, such as fevers, scurvy, syphilis, privation, sudden changes of diet—e.g. deprivation of accustomed alcohol–pregnancy, lactation, hæmorrhages, delay rather than permanently arrest the union of a broken bone. Alkaline urine, with an excess of phosphates, is found sometimes to be present where no other cause for the non-union can be ascertained to exist, or it may accompany one

of the above conditions. What influence the nervous system exercises over the union of fractures is uncertain. Cases of natural union in paralytic limbs have been recorded; but in one case of fracture of the lumbar spine, in which both the arm and the leg were broken, only the humerus united. Spontaneous fractures of ataxia reunite readily and rapidly, with an enormous formation of callus. The bones of lunatics seem to be more brittle than normal and break easily, but, unless there is some disease such as mollities ossium, they unite with readiness. Experiment has shown that division of the nerves of a limb has the effect of making the callus of a fracture, on that side, larger and harder than in one on the opposite side.

It is usual to classify cases of non-union under three heads: fibrous union, false joint, and absolute non-union. Fractures of certain bones—the patella, olecranon, neck of the femur (when intracapsular) and coronoid process—so usually unite by fibrous tissue, that, when in this condition, they can hardly be regarded as instances of ununited fracture.

Fibrous or ligamentous union, as it is sometimes called, may be effected by one or more bands, usually the former. The fibrous tissue appears to be the result of an arrest of the process of union, just when ossification should commence. Sometimes masses of bone are embedded in it; these are either comminuted fragments which have become encysted, or the result of limited ossification from separate centres. The neighbouring periosteum is often thickened, and other fibrous bands connecting the fragments may be formed by atrophied muscular tissue or interosseous membrane. The ends of the bone, in cases of long standing, are usually coated with fibrous tissue, somewhat atrophied, rounded off, and pointed; in other cases they are found enlarged and sclerosed, with, perhaps, irregular masses of callus around them. The medullary canal is usually filled in with an osseous or soft fibrous deposit, but may be patent from atrophy. In cases of *false joint* the ends of the bone are often expanded, eburnated, or covered with fibrous, cartilaginous, or fibro-cartilaginous material, one, perhaps, convex, fitting into the concavity of the other, and surrounded either by a proper fibrous capsule—a sort of unossified provisional callus—or by a capsule formed by the neighbouring soft parts. The interior of this capsule may be smooth or fasciculated, is often moistened by a synovia-like secretion, and sometimes contains loose bodies or has soft outgrowths projecting into its cavity. When the ends are more widely separated, a bursal sac, which does not enclose them, may be interposed. It is only in rare instances that the surgeon has to do with *absolute non-union*. The bones in such a case are atrophied; the limb generally shrunken, wasted, and useless; movement of the fragments is very free, and not imparted from one to the other.

The *diagnosis* of ununited fracture is easy. If in the lower limb, the patient either cannot walk at all, or, if able to do so, is aware of a sensation of 'giving' at the seat of fracture when the weight of the body is brought to bear on it. In the upper limb, the arm is more or less useless and perhaps flail-like; if the forearm is affected, there will probably be loss of the power of pronation and supination. There is frequently deformity at the seat of non-union, and the surgeon can, by manipulation, move one fragment on the other. The extent of this movement will depend much on the displacement of the fragments, the interval separating, and the consequent length of the uniting material between them. Very rarely, the fragments are so interlocked that there is but little impairment of the function of the part. Whether a case is one of fibrous union or of false joint must often remain a matter of doubt. Fibrous union is the more common, allows, perhaps, of greater movement, and is unattended by the crepitus that occasionally is met with in cases of false joint. If manipulation causes much pain, the uniting medium is said to be probably fibro-cartilaginous. In such cases union is probably only delayed, and they have a good prognosis.

Treatment.—It should be remembered that the union of some fractures is necessarily slow—e.g. where there is much displacement or great obliquity of the fragments; in such cases, patience and perseverance in the original treatment will probably be all that is required. Whenever any of the causes of delayed union enumerated above are present, the surgeon must at once direct his attention to its removal. A patient with scurvy must have fresh vegetables, fresh meat, and lime-juice; one with syphilis a course of mercury, iron, or potassium iodide, according as one or the other is indicated; one who is cachectic, weak, has undergone privation, or suffered from hæmorrhage, a generous diet and tonics; one accustomed to stimulants, beer and wine; a suckling woman must wean her child; a pregnant one may be assured

that, after delivery, her fracture will probably unite; a phosphatic and alkaline condition of the urine is best treated by a liberal diet and dilute mineral acids. Some of the local causes of delayed union, such as injury to the nutrient artery, are beyond the surgeon's control, but most can be avoided by careful treatment. If crepitus is elicited when the fracture is set, it is improbable that any foreign body, muscle, or other piece of soft tissue is between the fragments. Efficient application of splints and careful after-treatment should prevent either undue mobility or too rigid confinement of the fracture; if this has been oblique or there has been much displacement, extra time must elapse before the support afforded by splints is finally dispensed with. Necrosed pieces of bone, if not separating naturally, must be removed by operation. In neglected cases of fracture, where the delayed union is simply due to separation of the fragments, the surgeon, if the injury be at all recent, may by the use of continuous extension be able to a great extent to rectify the malposition, and so bring the parts into a more favourable condition for union or, failing to obtain this, for any operation that may be needed.

If delayed union follows treatment by splints and absolute rest in bed, the patient should be allowed to get up and go about in the open air with his fracture put up in a plaster of Paris, silicate of potash, leather, or pasteboard splint. In this way, the ends of the bone being rubbed together, the parts are excited to greater action and union may result. If the patient has already—from the first—been treated by the plaster of Paris bandage or some such immovable apparatus, it may be that a change to splints and rest in bed will procure consolidation. Frictions, shampooing, stimulating embrocations, or even blisters or issues over the seat of fracture, may also be tried. Mercury—even in non-syphilitic subjects—is sometimes given empirically. If after a reasonable time no union results, the case must be regarded as one of ununited fracture, and more severe measures will be necessary. Amongst the many operations that have been devised are the following:—

Dieffenbach's operation of drilling the bones and inserting ivory pegs into them. The pegs may be cut off level with the bone and allowed to remain, and often give rise to no irritation, or they may be removed at a subsequent operation. Some surgeons have used copper nails for the same purpose. *The introduction of gilt steel needles* into the bones under antiseptic precautions, has in Germany met with a good result. The needles are ten or twelve in number, and are retained for fifteen days.

Irritation of the unossified callus by *acupuncture*, or *subcutaneous incision* by means of a narrow-bladed tenotome, has also been practised. In performing such an operation, it must be remembered that large vessels—even the main artery of the limb—may be close, if not actually adherent to the fragments. *The passage of a seton*, silk or silver wire, between the ends of the bones is attended with the same danger of injuring important vessels or nerves: in some cases, where it is impossible to pass the seton between, it may be passed in the immediate neighbourhood of the fragments. *Drilling the bones* may be practised in many ways. The ends may be perforated in one or more places and the drills withdrawn; they may be left *in situ*, or, in suitable cases, passed right through from one fragment into the other, so as to hold them together. In such cases, the apertures should be made by a circular drill, and into these circular openings other drills, triangular on section, should be introduced, so that there may be thus provided an escape for the discharges. This operation has been practised by Sir J. Lister for ununited fracture of the neck of the femur. External incision may usually be dispensed with; if the bones be at all deeply situated, the insertion of long hare-lip pins may sufficiently mark out their limits and be a guide during the operation.

If, in addition to failure of bony union, there be irremediable displacement of the fragments, in itself sufficient to spoil the utility of the limb (e.g. great inversion of the foot, in a case of fractured leg), such simple operations as the foregoing must give way to the more severe measure of *resection*; and removal of more bone than just the ends of the fragments may be necessary to correct the malposition. Before, however, the displacement is put down as irremediable, it must be clearly seen that it is not due to or kept up by contracted tendons. If it were, tenotomy might make one of the milder operations feasible. Resection will also be needed when, although there is little displacement, other measures have failed, and probably in nearly all cases of false joint. It is now usually combined with wiring the fragments, the wire either being cut off close, hammered down, and left; or being twisted a known number of times, made to project from the wound, and subsequently removed. Since the in-

troduction of antiseptics, this operation is not to be regarded as of much danger when practised on most of the long bones. In the case of the femur, where a large deep wound is made, and much manipulation is perhaps necessary to bring the fragments together, the amount of discharge following the operation is usually so great as rapidly to soak through the dressings and make it a matter of some difficulty to keep the wound thoroughly aseptic; no such trouble is experienced with the other bones. Such resections are not nearly so dangerous as ordinary compound fractures in the same situations. The wound is made with a clean sharp instrument, with antiseptic precautions from the very first, the soft tissues are less injured, and the condition of the bone and medullary canal is usually, from previous pathological changes, such as to render them more tolerant of injury than when in their natural healthy state.

In performing resection it is well to render the limb bloodless, either by elevation or the application of Esmarch's bandage. As a rule only a single incision, if possible passing through a muscular interspace, will be required; but in the forearm, if both bones are implicated, two will be necessary; and sometimes, when the fragments of such a bone as the femur overlap much, and are deeply situated, it will facilitate matters if a separate incision is made on to each of them; the more dependent wound will be useful for drainage. The fragments may be drilled obliquely, or the wire passed through their whole thickness. The former is the easier, but more likely to split the bone; on this account, too, the saw is to be preferred to the cutting pliers for the actual resection. All periosteum should be preserved. In cases where both bones of the forearm or leg are ununited, the two upper or the two lower fragments may be found joined to each other. It is very essential in the forearm to separate and keep them apart, and to remove any redundant callus that might subsequently interfere with the movements of pronation or supination. The after-treatment of cases where resection has been practised resembles that of an ordinary compound fracture.

Nüssbaum's *transplantation of bone*, with antiseptic precautions, may be mentioned as another method of treatment. *See Bone-grafting* under GRAFTING.

Amputation should only be resorted to as a last resource, when other operations have failed and the limb is a useless encumbrance.

Mechanical appliances are most commonly used in ununited fracture of the femur; they may also be advisable for cases where, although resection and wiring has failed, the limb is still, with such a support, more useful than a stump would be, or when the patient objects to or is a bad subject for operation.

The *prognosis* after operations for ununited fracture is better when non-union is due to a local, than when it is due to a constitutional, cause; better, when irregular masses of callus show there has been an attempt at ossification, than when there is no such evidence; and better, when the bones are enlarged and sclerosed, than when they are atrophied.

GEORGE ROBERTSON TURNER.

URÆMIA. — This is a convenient clinical term used to indicate a condition in which peculiar phenomena, chiefly nervous, are exhibited as the result of the retention in the blood of matters usually eliminated by the kidney. These phenomena may either present themselves suddenly with great vividness and be followed by speedy recovery or death; or may come into being slowly, remain but slightly pronounced for a considerable time, and then quietly pass away with complete convalescence; or, on the other hand, become gradually exaggerated until they finally terminate in death. We speak accordingly of acute uræmia and chronic uræmia. The commonest cause for both of these conditions is one or other form of Bright's disease, but they may also be produced by mechanical obstruction, of one variety or another, to the flow of urine from healthy kidneys. In this way, the impaction of stones in the ureter or the pressure on the latter by a tumour may give rise to retention in the blood of those matters capable of producing uræmic symptoms, simply by throwing them back upon the kidney and embarrassing its free action.

The *symptoms* of uræmia are either suddenly developed in most pronounced forms without any warning, or are preceded by certain premonitions of a less distinct character. Among the latter may be mentioned slowing of the pulse and headache of a fixed kind, often referred to the back of the eyes or occiput; heaviness and mental inactivity are also noticed. The patient may also vomit once or twice in the morning without any evidence of dyspepsia, the vomited matter being watery and smelling of ammonia, or may have attacks of diarrhœa, or, again, may complain of dimness

of vision from time to time, which passes off completely. These premonitory symptoms, if they belong to uræmia, are usually followed, sooner or later, by acute evidence of the state of the blood. The most common is convulsions. These are of an epileptic character, and are usually accompanied by complete loss of consciousness, though not always. There is also biting of the tongue and foaming at the mouth. In the majority of cases, coma follows upon these fits and is usually deep, but coma may also appear without any previous nerve-explosion.

Uræmic convulsions may be single, but are more frequently repeated again and again, at shorter or longer intervals. During the stage of coma, the pulse is often quickened, the temperature rises, the teeth are ground, and there are twitchings of the muscles, and the fæces and urine are passed involuntarily. The pupils at the time are usually dilated and do not contract to light, but in some cases they have been found to be contracted or only of normal diameter. The face is usually pale all the time. In the intervals between the attacks the patient may appear quite well, and may recover vision completely, but often the sight of one eye at least remains impaired and the headache persists. The impairment of vision may be due to functional cerebral disturbance, which leaves no change in the eye appreciable by the ophthalmoscope, or may be due to actual changes in the retina, the result of the kidney-disease which leads to the uræmic symptoms. Of these organic changes in the fundus of the eye several are described. Dr. Gowers speaks of—(1) an œdematous swelling of the retina; (2) white patches of degeneration; (3) hæmorrhagic patches; (4) optic neuritis; (5) atrophy of the optic nerve and retina following the latter. Uræmic deafness is also occasionally noticed as a transient symptom, but is not so common as the ocular phenomena just mentioned.

The chronic condition of uræmia differs from the acute in that the fits are not so frequent and violent, and if there is any coma subsequently it is not so deep. Muscular twitchings, headache, itching of the skin, and morning sickness are, however, persistent. If the matters vomited are tested they are found to be of low specific gravity, and of alkaline reaction due to the presence of ammonia. Asthmatic attacks and hiccup are also noticed. The sleep is bad and disturbed by distressing dreams, and vision is frequently deranged.

All this assemblage of symptoms has long been recognised as depending upon the retention of excrementitious matters in the blood, but the exact nature of the latter and their mode of action have been the subject of much debate. Without going into the details of the controversies on these points, which have been ably handled by Dr. Ralfe, it may be pointed out that one of the earliest views with regard to the causation of uræmic phenomena was that of Christison—that it was due to the accumulation of urea in the blood. This was very soon abandoned in favour of the theory that it was not the urea itself, but the ammonium carbonate derived from its decomposition, which gave rise to the well-known symptoms. But this theory, too, was found to be unsatisfactory, as also that which laid the evil to the credit of an excessive quantity of potassium salts in the blood. Further, it was suggested that uræmic nerve-explosions were due simply to the mechanical effect of œdema of the brain, combined with anæmia brought about by the associated renal disease; but this theory again has not met with general acceptance. From a review of the whole subject, in the light of the most recent investigations, it appears probable, as Dr. Ralfe points out, that so-called uræmic phenomena are not caused by the toxic effects of one substance alone, but by the presence in the tissues of numerous other decomposition-products such as kreatin, leucin, and extractives, which have accumulated there and have actually brought about an alteration in their chemical constitution. He further lays stress upon the fact that in uræmia there is a considerable amount of acid unexcreted, and consequently diminished alkalinity of the blood. The reduced power of oxidation which accompanies this change must react powerfully on the tissues already loaded with decomposition-products, and especially on the nervous system.

The *diagnosis* of uræmia from epilepsy is often not easy unless the history of the case be known, and especially the state of the urine. But, as a rule, the turgidity of the vessels of the face and asphyxial symptoms are less marked in uræmia. From apoplexy the condition is distinguished by the absence of paralysis. In cases of opium-poisoning the coma is continuous; uræmic coma is often interrupted; the pupils, too, are not contracted, as a rule, in the latter condition, and the face is pale, while the breathing is not stertorous and is quiet.

ARTHUR E. BARKER.

UREA, one of the chief results of tissue-metabolism, is consequently found in

those organs and tissues where change is most active, always excepting muscle. Its occurrence and the means of recognising it in urine are the subjects of the following article, but may be fittingly prefaced by a few general observations.

Chemical Composition.—Urea is a prismatically crystalline substance, which, soluble in water, insoluble in alcohol, is easily decomposed by heat, fermentation, &c. On the other hand, it may easily be artificially made, so that its composition is now perfectly understood to be that of an amide, the amide of carbonic oxide, thus $CO\begin{matrix}NH_2\\NH_2\end{matrix}$, which (in the process of fermentation, &c.) is saturated with two molecules of water, the result being its metamorphosis into carbonate of ammonia. It is worth while digressing for a moment to point out here that this katalytic process, of such great practical moment in the surgery of the urinary organs, may follow as a result of three distinct conditions, one of which at least, however, is impossible (so far as we know), *intra vitam*—(1) Prolonged heating in the presence of water; (2) by the action of alkalies (this is comparable to No. (1)—viz. hydration); (3) by far the most important, the action of the so-called micrococcus ureæ, or possibly a product of its growth. *See* Septic Diseases, Classification of. It is interesting to note, what has been known for some time now, that this mode of decomposing urea is attended with slight result unless there are phosphates present. This is evidenced by the great difference in behaviour between a pure solution of urea and normal urine.

Relation to Tissue-change.—Urea being a product of metabolism, it now behoves us to consider its origin and practical import, since such must form a valuable aid to diagnosis, other things being equal. In the first place, it is quite fallacious to rest any opinion on an excess or deficit over or below the 'normal' amount passed, unless the two preliminary points—(1) the ingestion of nitrogen as food; (2) the amount of tissue-waste produced by exercise in various ways, pyrexia, &c., be fairly estimated and known. Forewarned in this way, the relation of the amount of urea passed, to the actual degree of tissue-change on the one hand, and the secretory power of the kidneys on the other, (*see* Urine) is a determinable fact within certain limits. The normal amount of urea passed by a healthy adult male in twenty-four hours varies from 30 to 35 grammes—i.e. from 450 to 525 grains. This amount is, of course, the *average* quantity from day to day, and is the total quantity excreted in the twenty-four hours. It must not be imagined that the excretion is regular, for examination of the urine at varying periods, between meals and directly after meals, shows that the amount of nitrogen got rid of is doubled according to the period examined.

The well-known increase due to pyrexial processes, &c. (Ringer), need not be referred to here, and for its relation to the excretion of uric acid, *see* Urine.

Quantitative Estimation.—The possibility of decomposing urea, uric acid, kreatin, &c., the nitrogenous constituents of the urine, by the action of an alkaline hypobromite or hypochlorite, enables the quantitative estimation of the amount of nitrogen excreted to be a comparatively simple matter now; the cumbersome and extremely uncertain method of Liebig being now superseded by the more accurate and more complete process of observing the total quantity of nitrogen in the urine.

The method requires little detailed description. A measured quantity (5 c.c.) of the urine is placed in a small tube or glass bottle, and this is then carefully lowered into a larger bottle, into which 25 c.c. of freshly prepared solution of hypobromite of soda have been previously poured. Without mixing the urine and hypobromite solution, this bottle is then firmly corked with an india-rubber stopper, through the centre of which passes a glass tube. Now, the mixing of the urine with the hypobromite will cause the katalytic destruction of the nitrogenous bodies contained in that fluid, and so produce the evolution of a definite volume of nitrogen. This gas, being led off by the tube perforating the india-rubber cork, can be measured by displacing water in a tube to which it is connected. By previous analysis of known substances this tube can be graduated at once, not merely in divisions which show the amount of nitrogen evolved, but also how much urea that amount of nitrogen represents, in percentages of the total urine. Perhaps the best (being the simplest and accurate) apparatus is that of Gerrard. To repeat: the amount of nitrogen given off by this means, and measured (as is customarily the case) in percentages of urea, represents not only the urea present, but also other bodies referred to above. In regard to the amount of uric acid passed, and its correlatives, carbamic acid and ammonia, it has recently been proposed to estimate these (when in mixture) by the use of sodium hypochlorite followed by sodium hypobromite.

Thus (Fenton): take two equal portions (*a*) and (*b*) of the solution, and from (*a*) measure the amount of nitrogen evolved by action of the hypobromite. Call this amount V_1. Treat the other portion (*b*) with the hypochlorite, and let V_2 = volume of nitrogen obtained. Act on the residue of this experiment with the hypobromite, and let V_3 = the volume of N. produced. And if

x = vol. of nitrogen due to urea,
y = ,, ,, ammonia,
z = ,, ,, carbamic acid,

then $x + y + z = V_1$,

$$\frac{x}{z} + y = V_2,$$

$$z = V_3.$$

After discounting the ordinary fallacies mentioned above as attendant on the deduction drawn from the amount of nitrogen excreted in the twenty-four hours, it is perhaps scarcely necessary to state that since the separation of urea by the kidneys, in normal physiological action, is now well known to be a direct process carried on by the epithelium of the convoluted tubules, it is obvious that we have a definite means of ascertaining the secretory power—i.e. the state of the kidneys—and therefore can form some idea of the ability of a patient to successfully sustain a severe operation. This point is, of course, of especial importance when such an operation is performed on the urinary tract. *See* URETHRAL FEVER.

VICTOR HORSLEY.

URETHRA, Diseases of the.—These include urethritis, with its consequences—warts, gleet, peri-urethral abscess, inflamed follicles, stricture, neuralgia, syphilitic, chancrous, and tubercular ulcers. Many of these affections have been described under the articles CHANCRE; GLEET; GONORRHŒA; STRICTURE OF THE URETHRA; SYPHILIS; URETHRAL FEVER.

URETHRITIS, following coitus with women suffering from leucorrhœa or other non-gonorrhœal muco-purulent discharge, is a milder affection than gonorrhœa, though probably often closely resembling that disease. But urethritis is not exclusively due to contagion. It may be caused by injury, by gout, or by tubercular disease. Nevertheless, all these forms are, in comparison with gonorrhœal urethritis, rare affections. Excessive beer-drinking in young men, and, in children, the irritation of worms in the intestines, are stated to sometimes cause slight urethritis. Again, certain vegetables—e.g. asparagus—and turpentine and cantharides are accused of exciting a mild urethritis, besides specially irritating the kidneys. Occasionally also, a very mild urethritis accompanies the early macular eruption of syphilis; it is always very limited, and subsides spontaneously.

In *traumatic urethritis*, the signs of irritation follow the passage of the calculus or other foreign body without delay. Soreness is felt at the first micturition after the injury has been inflicted; swelling and discharge are evident, at latest, twenty-four hours after the occurrence. Like other forms of urethritis, the traumatic variety may be followed by inflammation of the prostate, testicles, bladder, or kidney. Orchitis is, probably, the most frequent form of this secondary inflammation.

In *gouty urethritis*, the inflammation usually begins, and irritation is generally first felt at the membranous and prostatic portions, not near the meatus as in gonorrhœa, and causes greatly increased frequency of micturition. This irritability of the bladder, coming on at once and out of proportion to the amount of inflammation of the rest of the passage, is very characteristic of the gouty form. Patients who suffer from it have had also symptoms of gout elsewhere, or pass uric acid crystals. They are usually of full habit, over forty years of age, and addicted to the pleasures of the table. Too much reliance must not be placed on the gouty symptoms, inasmuch as gonorrhœa is not uncommon in men of the habits just mentioned. Gouty urethritis affects both sexes, though much more common in men. The inflammation may be as severe as it is in well-marked cases of gonorrhœa, pus being secreted freely; or it may give rise to the complications of the bladder, testis, joints, and eye which attend or follow gonorrhœal urethritis. The leading distinctions of gouty urethritis are—the history or presence of gout elsewhere, the usually scanty discharge, notwithstanding the great amount of scalding in the perineum and irritation of the bladder felt by the patient. Further. the symptoms are generally dispelled by remedies appropriate to gout. The termination of gouty urethritis is nearly always by resolution. If it is followed by prostatitis or epididymitis, abscess may form, and septic infection may possibly succeed, with its various consequences.

A very obstinate form of urethritis, probably allied to gout, is occasionally met with—the *eczematous*. In the cases which the writer has seen at the Lock Hospital and elsewhere, the patients have been between forty and fifty, of full habit, beer-drinkers, and suffering from eczema on the skin. In

these cases the surface of the glans around the meatus was bright red and very tender. The interior of the urethra for two or three inches, in one case as far as the membranous portion, was also bright red, but did not bleed readily when the endoscope or the bougie was passed along. There was a scanty, milk-white discharge, and the patient complained of constant burning pain along the urethra. Passage of urine or of instruments increased the pain greatly for the time. No further change appeared to take place in this obstinate affection; relief was given by cold water injections, or by the cold irrigation-coil round the penis, and benefit was derived from arsenic, alkalies, and careful diet.

Tubercular urethritis is at first an indolent affection, due to the slow ulceration of the tubercular products in the mucous membrane. The affection, though it may occur at any part of the urethra, is much more widely developed in the mucous membrane of the neck of the bladder. The discharge is scanty, often somewhat bloody. Soreness in the urethra during micturition is very slight, being generally little heeded in comparison with the severe burning pain and spasm of the neck of the bladder which accompany or follow every act of micturition. Should a sound be passed, intense pain is felt as the instrument reaches the ulcerated surfaces, which lie most commonly about the prostate, and before the bladder is entered. The extreme, unassuagable irritability of the bladder is characteristic, becoming in the end constant torment. The mucus secreted by the cystitis that spreads generally over the surface of the bladder sets up decomposition and produces ammoniacal, putrid urine, which irritates still more the ulcerated surfaces and excites the frequent spasm. Tubercular disease in time spreads to the body of the prostate, the vesiculæ seminales, and the epididymes, and thus gives corroborative evidence of the nature of the urethritis.

The terminations of tubercular disease may be cicatrisation of the ulcers, when the contraction of the cicatrix may produce stricture in rare cases; but, usually, death is caused by the tubercular disease spreading to the bladder and kidneys, causing death by their destruction, or by developing acute tuberculosis of the lungs or other viscera.

The *treatment* of traumatic urethritis consists in the first onset of allaying irritation by salines, diluent drinks, low diet, and aperients. When severe, the patient must rest in bed; should spasm and irritability of the bladder come on, 5 to 10 minims of tincture of belladonna should be given in camphor water every four or six hours, with careful watching of the effect of the drug on the patient. Warm poultices and fomentations of the perineum are beneficial; and, if abscess form there, its contents must be immediately let out. Should urinary fever with partial suppression of urine set in, the treatment proper to that affection must be adopted. Usually, the slighter forms of traumatic urethritis subside in a few days, if the exciting cause be removed or not applied a second time; but it may be a serious and dangerous affection.

In treating the gouty urethritis, more benefit can be obtained by attacking the general condition than by treating the local affection. Free purging, with mercurial and other cholagogues, and citrate or bicarbonate of potash with colchicum, in frequent moderate doses, are needful. These measures, with low diet and continued abstinence from food likely to excite gout, aided by hot baths and other sudorifics, usually arrest the irritation quickly. Care in avoiding all but very moderate exercise, and the support of the testicles in a suspensory bandage are requisite to prevent the urethritis from causing prostatitis or epididymitis. The gleet left by the urethritis is obstinate, being mainly secreted in the prostatic portion of the canal and from its ducts. Local treatment and counter-irritation usually aggravate the discharge; better results are gained by persevering with the treatment for gout, and, when that condition is quiet, by administering ℥v. to x. of copaiba or 15 to 20 grains of cubebs, or some similar remedy, three times a day. Obstinate cases are often thoroughly cured by a course of saline waters, such as those of Homburg or Plombières, Bath, Carlsbad, or Töplitz.

In tubercular urethritis, the treatment is mainly that useful to combat the tubercular disease—rest, warmth, dry sunny climates, nourishing food, cod-liver oil, and iron. The spasm and pain often require large doses of belladonna and morphia in suppositories and by the mouth. If cystitis supervene, washing out with a solution of boric acid of half the saturated strength gives relief for a time; but drainage through a perineal opening is necessary to prevent the accumulation of urine in the bladder, when the cystitis is marked and the patient worn by pain and spasm.

Neuralgia of the Urethra.–This term is given to a painful affection of the urethra,

occurring when no disease can be detected in that part of the urinary apparatus.

The *causes* of the affection are very numerous, and may be divided into two groups: those referred to general disturbance of the nervous system and those connected with reflex irritation set up by local disorder of neighbouring parts. It is most frequent in the male sex and during the middle period of life; but it is not unknown in women and children. It may follow excessive coitus, masturbation, and repeated sexual emotion, or accompany neuralgia of other parts of the body. A superabundance of phosphates or of uric acid in the urine is also a frequent cause. Of causes of a reflex kind are—disease of the kidney, constipation, flatulent dyspepsia, fissure of the anus, piles, uterine disease; of causes more closely connected with the urethra are congenital narrowness of the meatus urinarius, enlarged prostate, stone or atony of the bladder. Lastly, in some cases none of these causes can be detected to explain the painful condition of the urethra.

The *symptoms* of this affection are—increased frequency of micturition, smarting pain, and difficulty in voiding urine; sometimes also a sense of heat and itching at the tip of the penis; aching pain beginning in the penis and radiating to the pubes, groins, loins, buttocks, and thighs. This is a not infrequent form, often recurring and ultimately almost continuous. In some persons the physical pain is accompanied by mental despondency, irritable temper, or dread of society.

The course of the affection is very capricious, irregular, and intermittent. It often assumes a certain periodicity, or comes and goes without obvious cause. The disorder thus affords long intervals of freedom from pain, to return when the general condition has been disturbed by some of the diathetic causes already mentioned. Sometimes, the passage of a small quantity of highly acid urine will bring on an attack of neuralgia, which copious draughts of simple diuretics, water, barley-water, or weak gin and water will speedily allay.

The *diagnosis* is formed chiefly from the obstinacy and severity of the pain with complete remissions, the absence of congestion of the mucous membrane and of discharge, and the existence of some of the causes of neuralgia already mentioned. Not infrequently the diagnosis is reached by the simple process of exclusion.

The *treatment* resolves itself into removal of any local disease which excites the neuralgia, if that be curable; and the palliation by anodynes, regimen and diet, of those, such as renal or prostatic disease, which are incurable. The phosphatic diathesis is remedied by tonics, mineral acids, fresh air and exercise, and sufficient amount of animal food. There should be also prohibition of coffee or strong tea, as those beverages are prone to cause precipitation of the phosphates and consequent painful micturition. To these measures, in obstinate cases, may be added a change of climate from a cold damp one to a warm sunny one. A course of saline aperient waters at Kreuznach, Harrogate, Carlsbad, and other baths is useful; or, if this be not procurable, free purging by saline aperients, when excess of uric acid depends or accompanies defective action of the liver, is often effective in procuring a cure.

For local treatment, the most efficacious remedy is the repeated passage of bougies and sounds. Usually, this operation is much dreaded by the patient, and causes him at first considerable pain of a hot, burning character. But if great gentleness be exercised and small pliant bougies be employed until the urethra has lost its hyperæsthetic condition, the suffering is only momentary, while the diminution of the constant irritation encourages the patient to submit to a repetition of the operation. When the passage has grown accustomed to bougies, full-sized steel sounds, well heated and oiled, may be passed twice or thrice a week until the neuralgia is considerably abated. Recourse may then be had to cold injections, cold hip-baths and other local stimulants of the circulation through the genitals. Repeated blisters to the perineum, produced by painting an area of half an inch square along the raphé with blistering fluid, are valuable when there is any tendency to prostatic congestion; but, to do good, blisters must be persevered with for several weeks.

Warts, as little pedunculated or sessile projections, identical with those seen in the furrow behind the glans or on the glans and inner surface of the prepuce, are a not uncommon affection of the mucous membrane. They are situated usually in the first inch beyond the meatus, though sometimes they can be seen by the endoscope growing at a greater depth from the surface. It is probable that true warts are not found more than three inches from the meatus. Again, they occur in persons who have a proclivity to them—that is, have warts on the glans or prepuce as well, or who have had them in boyhood on the hands or elsewhere. Urethral warts are always consequences of

gonorrhœa, and do not arise without the stimulus of acute irritation. In structure they are simple papillomata, and vary in size from that of a pin's point to that of a small pea. So long as they remain in the urethra, they give rise to itching and tickling there and secrete discharge. They are easily removed by touching them with an astringent solution or by snipping them off, when they are within reach. Those which are seen only with the endoscope, are destroyed by touching them with a solution of nitrate of silver of twenty grains to the ounce of water.

Peri-urethral Abscesses are also nearly always a consequence of gonorrhœa, and may begin at any part of the canal. Most frequently they develop just within the meatus, between the under surface of the urethra and the frænum preputii further on, or at a point about three inches from the meatus. They begin either by inflammation of a closed follicle, or as abscesses having no communication with the urethra, and spread both towards the skin and towards the mucous membrane. They may open on both surfaces, but most commonly do so externally. When forming beneath the frænum, they are often of slow growth and form a prominent swelling on either side of it. When they have broken, the pus escapes, but the cavity is slow to heal, and the pus collects again and again, to be discharged from time to time through a minute aperture. Should the abscess force its way to the urethra, it usually also opens on to the skin and thus produces a urethral fistula. If the abscess have formed in the part behind the bulb, the depth of the situation causes the abscess to be long in reaching the surface, and it may percolate between the layers of the superficial fascia to the scrotum or at the side of the crus penis for a considerable distance, before it makes its escape.

If the deeper abscesses break into the urethra, a troublesome purulent discharge remains, and the cavity of the abscess fills from time to time and may obstruct the flow of urine along the urethra.

The *treatment* consists in early puncture, and the maintenance of a free outlet for the pus until the cavity is closed by granulation. If there be a fistula, this usually closes in a short time, provided there be no obstruction, by stricture or otherwise, to the passage of urine by the urethra. Hence, the urethra must be searched for contractions, and any that are present be widened by treatment. The little obstinate pouches of matter, which lie on either side of the frænum in the furrow, are best treated by a free incision, and plugging the interior of the cavity with iodoform lint to ensure drainage and granulation.

Berkeley Hill.

URETHRA, Foreign Bodies in the.—Foreign bodies found in the urethra have either entered that canal directly from the external urinary meatus, or have passed into it after a long or short residence in the bladder. Calculi of purely renal or vesical origin arrested in the urethra are not referred to here, but are fully discussed under Stone in the Urethra. Foreign matters obtain entrance into the bladder and thence into the urethra, either through injuries which cause penetrating wounds or in consequence of disease. As the result of direct injury, shot, pieces of clothing, or fragments of bone are met with, while portions of bone, the contents of dermoid cysts, fruit-stones, and other fæcal matters from the intestines, are consequences of disease. *See* Foreign Bodies in the Bladder.

Most usually, the urethral foreign body has been introduced directly from without, through the external meatus, and is a portion of bougie or catheter which has become detached while the instrument has been lying in the canal; but straws, pieces of pencil, quills, penholders, pebbles, fruit-stones, pins and needles, are not infrequently passed into the urethra, and allowed to pass beyond reach of recovery. Such bodies are introduced by patients themselves for the treatment of real or supposed disease, or as a means of inducing improper excitement of the sexual organs. Sometimes they are passed in by others from curiosity or mischievously, when the sufferer is asleep or drunken.

The discomfort occasioned in the urethra varies with the nature of the foreign body. It may cause retention of urine with all its troubles and dangers, or inflammation of the urethra, with considerable constitutional disturbance, may result. Sometimes little immediate discomfort is experienced, the foreign body becomes impacted and gradually is encrusted with urinary salts. The diagnosis is made by first examining the urethra externally through the penis and perineum, and with the finger in the rectum. Afterwards, a small sound may be introduced into the urethra, and the nature and position of the foreign body more accurately ascertained. Care must be taken, in making this examination, not to push the body further down the urethra or into the bladder. Much ingenuity has been expended upon the invention of urethral

forceps for the extraction of foreign bodies, and there are numerous varieties, but the best is, perhaps, that one known as the simple, long urethral forceps. The long urethral scoop or curette is a useful instrument, and a loop of silver wire may be made to do good service.

Treatment.—If the foreign body is engaged in the penile portion of the urethra, its further progress towards the bladder should at once be arrested by tying a piece of elastic drainage-tube, or an india-rubber catheter firmly round the base of the penis. Here it may be remarked, that all foreign bodies which are elongated and therefore possess distinct ends, when once engaged in the urethra, will naturally pass inwards or outwards according as the end which offers least resistance is directed outwards or inwards. Thus the end of a broken catheter will tend to pass rapidly into the bladder, owing to the action of the muscular fibres of the urethra, because the rounded non-resisting end is towards the bladder and the rough resisting end is directed outwards. Round, smooth, urinary calculi, drops of urine, semen, and pus, are all expelled outwardly. If the patient has plenty of urine in his bladder at the moment of the introduction of the foreign body, the urethra may be injected with olive oil, the meatus pinched between the finger and thumb, and the patient directed to make a full stream of urine forcibly, when, upon the meatus being released, the foreign body may fortunately be expelled. If, however, it is not expelled, the surgeon may attempt to manipulate the body through the walls of the urethra, and so squeeze it out.

If this plan is not successful, the urethral forceps or scoop must be carefully tried. Their use is usually very distressing to the patient, and sometimes an anæsthetic has to be employed. The patient must lie on his back, and the surgeon should steady the foreign body and prevent its being passed further down the urethra by pressing behind the body upon the urethra, either in the penis or perineum, or with his finger in the rectum. The forceps may then be passed down to the foreign body, and a careful attempt made to extract it. Sometimes the surgeon will succeed with the urethral scoop or curette, when he has failed with the forceps. If the foreign body be a piece of gum elastic bougie or catheter, and a small gum catheter can be passed by its side into the bladder, it will often be well to tie this catheter in for a few days, in the hope that on its withdrawal the vagrant piece of catheter will come away also, having become glued to the inlying catheter. This method should only be tried when an attempt with the forceps has failed. The knife can rarely be required to cut down upon a foreign body in the urethra. Such a proceeding is, however, occasionally justifiable, and it is most proper to do so if the body is engaged behind an organic stricture of the urethra. In such a case, after the body has been removed, the stricture should be thoroughly divided internally or dilated, otherwise a fistula will almost certainly result. In cutting down upon a foreign body, care should always be taken to draw the skin of the penis well forwards; after the operation the incisions into the skin and into the urethra will not correspond, and the parts will rapidly heal.

Occasionally, foreign bodies of a peculiar character will be met with in the urethra, which will tax the manipulative skill of the surgeon. Hairpins and shawlpins have sometimes called for exceptional ingenuity. A hairpin is usually introduced with the bent portion towards the bladder. Directly the pin has passed from the patient's grasp, the legs of the pin spring apart and the ends become firmly fixed into the urethra. In such a case a metal tube (a piece of silver catheter) may be passed down to the pin, the legs of which are firmly pinched together through the urethral walls, and slipped into the metal tube, which is then withdrawn, bringing away with it the pin safely. Another plan of dealing with such a case is to hold the penis forcibly against the abdomen, and with the finger in the rectum the ends of the pin may be made to protrude through the walls of the urethra and skin of the penis. One leg of the pin may then be cut off close to the skin and the the rest of the pin twisted out. A shawl- or large-headed pin may be treated in much the same way, supposing the head of the pin to have been passed in first, towards the bladder. The point may be pressed out through the urethra and skin, and then brought well down towards the patient's anus; the head of the pin can then be pushed up to the external meatus and the whole pin removed.

In the performance of lithotrity, the jaws of a lithotrite loaded with débris may become fixed in the urethra. If this is due to stricture, a small tenotome may be introduced under the skin, the stricture divided subcutaneously, and the lithotrite withdrawn, or the blades of the lithotrite may be cut down upon, then protruded, cleared of all débris, approximated, and withdrawn by the natural passage. G. Buckston Browne.

URETHRA, Injuries of the.—These are caused by falls, kicks, blows on the perineum or penis, by gunshot wounds, cuts, by twisting the penis during erection, or blows given to relieve chordee, by the tying of strings tightly round the penis, and by the impaction of calculi or the passage of foreign bodies (such as catheters) along the canal. The consequences are bruises, lacerations, incisions, sloughing and loss of substance; afterwards, as results of this loss of substance, firm fibrous stricture or complete obliteration of the urethra for a short distance.

Of perineal injuries, a frequent cause is falling when walking along the joists of an unplanked floor. The legs slip between the joists, and the perineum is violently struck against one of them. By this accident the bulbous or membranous portion of the urethra may be simply bruised, lacerated along its floor, or so completely divided that its continuity is lost.

When the perineum is struck the amount of hæmorrhage is often considerable. As the skin is seldom divided, the blood, escaping into the cellular tissue, causes swelling of the perineum and scrotum; the skin of which quickly turns purple or black. There is much pain and general shock, and there may be inability to void urine from the compression of the extravasated blood on the urethra. If the urethra be torn as well as bruised, blood, usually in small quantity, escapes from the meatus urinarius. Occasionally, the flow of blood from the urethra is dangerously copious. After this accident, if the neck of the bladder as well as the urethra be injured—a complication that is more common when the injury to the urethra is secondary to fracture of the pubic bones—the urine escapes from the bladder at once, not waiting until the patient attempts to micturate before it invades the cellular tissue of the perineum, scrotum, and integuments of the abdominal wall. When the urethra alone has been lacerated, the bladder retains its contents until the patient passes urine; then several consequences may follow. The urethra may be blocked by coagula, and the urine consequently be driven through the tear in the urethra, and extravasation take place. Or urine is voided through the meatus in great part, a small quantity only escaping into the cellular tissue, at once exciting irritation there. The contact of urine with the wounded surfaces materially increases the patient's sufferings. A stinging pain is felt, and great anxiety and prostration ensue, which continue until an outlet is made by sloughing and abscess, when the urine escapes through the gaps caused in this manner. Finally, the urine continues to escape through these artificial channels, which contract to fistulæ, the perineum is thickened by numerous tough scars, and the urethra is tightly contracted by fibrous stricture. Not infrequently the patient is exhausted by pain and irritation, and dies before the process of repair and cicatrisation begins. The diagnostic sign of bruise of the urethra is the immediate escape of blood by the meatus urinarius; that of laceration of its walls, a pricking, stinging pain, felt when the patient proceeds to pass urine. This act is often involuntarily performed immediately after the accident, through the fright and shock caused by the injury.

The *treatment* of cases of injury to the perineum by falls or blows is regulated by the amount of injury the urethra has received. If it is only bruised, but no aperture is made in its wall, the patient must be kept in bed, opiates and restoratives being given as needful. Cold evaporating lotions, ice-bladders, and leeches should be applied to the perineum if the rupture of the vascular structures of this region (erectile tissue, transverse perineal arteries, artery to the bulb), cause rapid swelling from extravasated blood. If these methods fail to check the swelling, a catheter must be passed to the bladder and tied in, while firm pressure is made against the perineum with a padded crutch fixed by bracing it firmly to the thighs above the knees. The catheter should be a silver one, No. 10 or 12 of the English scale, because the point of such an instrument can be most readily guided along the roof of the urethra, the part least likely to be injured. If, though the hæmorrhage be not excessive, retention from coagula blocking the urethra comes on, a catheter should be tied in and retained for a week, to give time for the wound in the urethra to heal sufficiently to prevent urine escaping into the cellular tissue, after the catheter is withdrawn.

When besides the free escape of blood *per urethram*, there is complaint of pricking pain, with more or less difficulty in voiding urine, while the swelling increases steadily, an attempt should be made at once to pass a silver catheter to the bladder. If it reach the bladder, the further steps for opening the perineum are followed with greater confidence. But, if the bladder be not reached, the instrument should be passed as far as it will go along the urethra, and an incision be made

at the point where its beak is arrested. The incision must always be carried scrupulously along the middle line to give free escape to the urine, to avoid wounding important blood-vessels, and to increase the probability of reaching the urethra behind the injury. If this is found, and a guide can be carried along it to the bladder, a tube must be passed to it and tied in. When the bleeding is small, a flexible tube of india-rubber or of 'gum-elastic' may be carried through the wound to the neck of the bladder, to bring away the urine as fast as it reaches the bladder from the kidneys. If there be free hæmorrhage after the perineal incision is made, which is a very uncommon event, the flexible tube may be replaced by one of hard rubber or a stiff lithotomy tube with a petticoat or Brown's tampon, and the wound plugged round the tube for a few hours till the bleeding stops. Every wandering collection of urine in the cellular tissue of the scrotum, groins, or abdominal wall should be opened by incisions, and allowed to drain into warm boric acid dressings.

If, after the perineum has been opened in the middle line, the urethra be not readily found, it is best to desist from further search for the canal until the lapse of a week has allowed the swelling to subside. The gap in the urethra by which the urine escapes will be then found with ease, and the remainder of the passage to the bladder traced. This direction for delay implies, of course, that there is no retention, that the urine escapes through the laceration in the urethra, and by the incision in the perineum to the surface. When retention is present, the distended hinder portion and neck of the bladder are not usually difficult to discover. If, nevertheless, the opening cannot be made out, the bladder must be punctured *per rectum* and a catheter tied in through the puncture.

Great cleanliness is necessary, and support by nutritious food and opium must be given freely.

The urethra is sometimes lacerated in attempts to relieve chordee by resting the erect organ against the edge of a table and striking it a sharp blow. The distended corpus spongiosum is ruptured, and occasionally the urethra also, when free hæmorrhage *per urethram* takes place. The consequences are often abscess in the corpus spongiosum, and fibrous stricture of the urethra at the site of the injury.

Another mode of damaging the urethra is to tie a string tightly round the penis or to slip a ring over the glans, thereby causing swelling and sloughing of the constricted part and fistula.

Among foreign bodies which injure the urethra the most common are metallic catheters or sounds, used by surgeons or by the patients themselves in attempts to treat stricture; the lacerations are called 'false passages.' They are usually single; but occasionally there may be two or three such false routes. The urethra is perforated most commonly in the floor or at the left side of the passage; and the perforation is made in front of the stricture or at the bulbous portion, before the triangular ligament is reached. The false passage passes backwards between the urethra and rectum. Sometimes it enters the urethra again behind the stricture; though more frequently it penetrates into the rectum. If left alone, these passages will sometimes close; but more often they remain permanently open, and render the patient liable to abscess or urinary fever, if a catheter be pushed into them on any occasion.

Calculi while drifting from the bladder to the meatus may become lodged in the irregularly shaped prostatic portion, or in the narrowest portion of the urethra, the last three inches. There they may cause ulceration and abscess, and even work their way out of the body by this means. In the prostate they nearly always remain as permanent causes of pain, irritation, and suppuration. In the penile urethra, the immediate effect of their impaction is usually retention of urine; and in attempts to relieve this obstruction or to withdraw the calculus, the urethra is often seriously injured. If the calculus is tightly fixed in the penile portion, it may be successfully removed through a longitudinal incision made over it, which incision should be at once sewn up, and the urine drawn by catheter from the bladder while the wound unites. If the stone be not fixed it may be pushed back to the bladder, where it may be crushed or extracted by lithotomy. *See* Stone in the Urethra.

A great variety of articles have been pushed or let slip into the urethra, such as hairpins, pen-holders, catheters, &c. Sharp-pointed articles like hairpins can be extracted by bending the urethra over the point of the pin until it projects through the skin. It can then be seized and withdrawn. If the foreign body to be extracted lie in the membranous portion of the urethra, a finger should be kept in the rectum during these manipulations, to prevent the body from slipping into the bladder. *See* Urethra, Foreign Bodies in the. Berkeley Hill.

URETHRA, FEMALE, Affections of the.—The female urethra, measuring about one and a half inches in length, extends downwards and forwards from the neck of the bladder to terminate externally in the opening known as the *meatus urinarius*, situated in the middle line immediately in front of the vaginal orifice. The canal, which lies more or less completely embedded in the anterior vaginal wall, is narrowest at its external orifice, and admits throughout of great distension—a fact of considerable importance in relation to the diagnosis and treatment of certain affections of the bladder.

Artificial dilatation of the urethra for diagnostic purposes may be readily effected by the use of graduated bougies or specula, or even by means of the finger alone in certain instances. Experience has shown that *rapid* dilatation, carefully performed, is on the whole preferable to the more gradual methods of procedure, as being less likely to be followed by incontinence of urine.

I. Malformations.—1. *Congenital* defects due to imperfect development are of very rare occurrence, and are commonly co-existent with some malformation of the adjoining parts. The following may be mentioned as well-recognised conditions: (1) total absence of the urethra; (2) defect of its external portion (hypospadias); (3) defect of its internal portion; (4) atresia of the canal.

2. *Acquired* conditions, affecting the calibre of the canal or its direction, may arise from various causes.

Dilatation of the urethra in whole or in part, due to a relaxed state of its walls, may result from displacements of the canal, accompanied by inflammatory thickening of its lining mucous membrane (conditions usually traceable to child-bearing); or may be consequent upon mechanical causes, as stricture, or the presence of neoplasms, calculi, &c. The *symptoms* vary according to the extent and the exact seat of the dilatation, while further depending upon the state of the mucous membrane, which, when inflamed or prolapsed, will give rise to frequent and painful micturition.

Dilatation of the *lower third* of the canal often causes no functional derangement whatever, unless ulceration or inflammation exist.

When there is dilatation of the *upper third* of the urethra, the patient is usually subject to partial incontinence of a most distressing character.

In dilatation of the *middle third* (*sacculation*, *urethrocele*), there is recognisable a pouched swelling in the anterior vaginal wall, into which a catheter can be passed. Micturition is frequent, and accompanied by straining efforts consequent upon reflex tenesmus excited by the retention of decomposing urine in the pouch, of which the involuntary escape on exertion usually renders the patient's condition one of extreme discomfort.

Treatment.—An inflamed or relaxed state of the mucous membrane *in the neighbourhood of the meatus* may be remedied by the use of astringents, such as tannic acid or alum. Should these fail, redundancy of the prolapsed mucous membrane may be dealt with by applying the fine point of the thermo-cautery to a narrow strip on each side, parallel to the axis of the canal, so as to avoid stricture of the meatus from subsequent contraction of the cauterised tissue. Or, if necessary, a narrow V-shaped portion of mucous membrane may be excised, and the edges adapted by fine sutures.

Dilatation of the *upper third* of the canal must be treated simply by the use of a suitable anteversion pessary.

The surgical treatment of *urethrocele* consists in excising an elliptical portion of the anterior vaginal wall, so as to completely open the cavity of the pouch, the lining membrane of which is to be carefully dissected off as far as the aperture communicating with the urethral canal. The freshened surfaces are then thoroughly coapted by deep sutures of fine silver wire, so passed as to include the margins of the opening in the floor of the urethra. These should be left undisturbed for eight or nine days, a catheter being meanwhile retained in the bladder for the first four or five days after operation.

Stricture.—A much less common affection in women than in men. It may occasionally be met with as the result of inflammation or ulceration due to specific disease, or consequent upon the use of caustics. Cicatrices in the vaginal wall, resulting from injuries during childbirth, may also give rise to contractions of the canal, which, again, may become permanently narrowed from disuse in cases of long-standing vesico-vaginal fistula.

The chief *symptoms* caused by stricture are frequency and difficulty of micturition.

Treatment.—Stricture of the *meatus*, the most common form of contraction, may be either divided or forcibly dilated,

methods o treatment equally applicable to strictures of inflammatory origin seated higher up in the canal. In cases of contraction of the entire urethra, gradual dilatation by bougies should be practised.

Displacement of the urethra in an *upward* direction may be caused by the presence of a pelvic tumour pushing the bladder up out of the pelvis. *Downward* displacement, to a greater or less extent, invariably accompanies prolapse of the bladder (cystocele). Incontinence of urine or difficulty of micturition, according to the degree of displacement, results from this condition.

Treatment must aim at the rectification of the prolapse.

II. Foreign Bodies in the urethra may either come from *within*, as calculi or substances which have entered the bladder by perforation of its wall (fœtal remains, hydatids, fæcal concretions, gall-stones, &c.), or may have been introduced or have penetrated from *without*. In any case the chief *symptoms* are retention with pain and tenesmus. Injury to the wall of the urethra may cause hæmorrhage, and be followed by peri-urethral inflammation.

Treatment.—Extraction of the foreign body is to be effected with the help of fine forceps or with a wire loop, guided by a finger in the vagina. Care must be taken to avoid laceration of the parts.

III. Urethritis. — *Inflammation of the Lining Membrane of the Urethra.*—The *acute* form is commonly, although not necessarily always, of specific origin. In such cases its onset is usually sudden, being preceded or accompanied by inflammation of the vagina and vulva. The prominent *symptom* is urgent and painful micturition (scalding), occasionally followed by hæmorrhage from the meatus. The urethral discharge may be revealed by pressure along the course of the canal in the vagina.

Treatment consists of the use of local baths, with the employment of sedative vaginal suppositories. Free purgation, followed by the administration of salines with hyoscyamus, usually answers well. In *subacute* cases the cautious injection of a solution of nitrate of silver or sulphate of zinc may be tried. In *chronic* cases the passage twice a week of a full-sized bougie has been recommended.

The existence of a *fissure* in the immediate neighbourhood of the neck of the bladder resulting from a urethritis may be the cause of great discomfort, tenesmus, and pain both during and after micturition. The endoscope is essential for its discovery and treatment, which can be effected either by the application of nitrate of silver fused on a fine probe, or by incision as practised in fissure of the anus.

IV. Fistula.—For *complete* or *urethro-vaginal* fistula, *see* Vaginal Fistulæ. *Incomplete internal* urethral fistula may be met with as a blind sinus extending downwards from the floor of the canal, as the consequence of a peri-urethral abscess. Its existence can be detected by the passage of a probe *per urethram*, while the finger presses upon the anterior vaginal wall.

The *symptoms* to which it gives rise are pain and frequency of micturition, with vesical tenesmus; there is usually a constant sense of heat and discomfort about the part, and occasional traces of pus occur in the urine.

Treatment.—The sinus should be converted into a *complete* urethro-vaginal fistula, which may be subsequently closed by operation if it be found necessary to interfere surgically.

V. New Growths.—Of these the most common form is that known as *vascular growth of the meatus* or *urethral caruncle*. *See* Vulva, Affections of the.

Varices of the urethral veins, analogous to rectal hæmorrhoids, most commonly affect the floor of the canal, and may occasionally cause obstruction to the flow of urine. The occurrence of submucous rupture of an over-distended vessel will lead to the formation of a urethral *hæmatoma*. *Treatment* should be directed to the relief of the impeded circulation.

Cysts of glandular origin are not common, but may be met with at any age. If polypoid in shape, they may cause obstruction.

Fibrous growths are of rare occurrence. They are met with embedded in the urethral wall; or as projecting polypi, usually seated in the neighbourhood of the meatus.

Sarcoma urethræ has been described, but the affection is an extremely rare one.

Epithelioma of the female urethra, whether of primary origin or secondary by extension, is also of very uncommon occurrence.

The *symptoms* caused by urethral neoplasms are pain and difficulty in micturition, sometimes amounting to complete retention, partly due to spasm. Dyspareunia and a train of nervous symptoms are occasionally traceable to their presence. The more vascular growths may give rise to hæmorrhage.

A growth presenting at the meatus will be readily detected; when seated further up in the canal, its presence may be recognised by pressure of the finger along the course of the urethra in the vagina. Dilatation of the meatus and the introduction of the urethral speculum will facilitate the investigation of its nature.

Treatment.—Extirpation of *non-malignant* growths is to be effected by caustics, or by means of the ligature, by torsion, or by excision. The curette, the écraseur, or the galvano-cautery may be advantageously employed, care being taken in any case to effectually remove the whole of the new growth. W. A. Meredith.

URETHRAL FEVER, or the pyrexia frequently following mechanical treatment applied to the lower urinary tract, is a condition which, in all probability, is due to direct disturbance of the central nervous system—i.e. the spinal cord and the medulla oblongata—and which presents all the symptoms of an acute specific fever.

Etiology and Causation. — Urethral fever, as its name signifies, is dependent for its origin on certain conditions of the urethra. If the mucous membrane of that passage is irritated by some means or other, there follows a rise of temperature, rapid or gradual according to circumstances detailed below, the pyrexial rise being accompanied by a shivering fit or cold stage not long before the temperature reaches its maximum. As may readily be observed, the symptom of shivering or shuddering is sometimes seen in healthy persons in whom the urethra is perfectly normal, but irritated by the mere flow of urine, as in the simple act of micturition. But, further than this, the symptom of pyrexia may also be observed, in a very mild degree, as a result of stimulating the normal urethra. An artificial fever is thus sometimes seen, clinically, to follow the passage of a catheter for some trifling inability to pass water, owing to reflex spasm, &c.

What occurs thus in health, is repeated on a wider scale and with far greater intensity in disease. Since, however, every degree of constitutional disturbance can be found between the slight shivering, &c., observable in healthy people and the most severe or fulminating variety of the pathological pyrexia, we have good ground for believing that the two things possess a common cause; and this is to be found in the fact of there being, in each instance, a disturbance of the central nervous system by irritation of the periphery. We can scarcely do more here than refer to the articles on Rigor, Surgical Fever, and Neurotic Fever, for an explanation of the manner in which nerve-irritation may be supposed to evoke such symptoms, and will pass on to examine the scanty etiological facts which help to explain several differences in the clinical histories of cases of this affection.

It was shown by Fergusson that urethral fever occurred most severely in those patients who had not been previously catheterised, and that where instruments had been freely used, constitutional disturbance was very exceptional. This partly expressed the facts of the case, since about forty per cent. of the cases, in which the severest form of urethral fever occurs, are those which have undergone no previous treatment whatever. The principal factor, however, in the causation of urethral fever appears to be the age of the stricture. Thus, the average age of the stricture in cases of fulminating urethral fever is less than eighteen months, whereas in the milder forms it is as much as eight years, and in 'apyretic' cases much older still. The simplest explanation of these facts is that we have, in urethral fever, to do with a fever which is essentially neurotic in origin. *See* Neurotic Fever. In a recent stricture, the nerve-fibrils and nerve-endings (already hypersensitive from the specific inflammation of the surrounding tissues) are capable of transmitting a severe shock to the spinal cord, &c.; while in an old stricture, we may very justly assume this peripheral nerve-supply to be considerably damaged by the shrinking of the stricture-cicatrix, so as to make it more or less insensitive to mechanical irritation.

A very important element in the causation of urethral fever is the mode of instrumentation which evokes the pyrexia. To put this question most briefly, we may say that laceration is more productive of fever than is incision. Thus, it occurs more frequently in cases which have been subjected to catheterism and rupture of the stricture, than in those where division has been effected with a urethrotome. A predisposing cause of great influence is that of malarial fever, as pointed out by Fayrer. If a patient with stricture have previously suffered from some form or other of malarial fever, he is practically certain to be the victim of urethral fever if his stricture is treated mechanically, unless certain prophylactic measures are taken. See *Treatment* below. Other predisposing factors are to be found in other causes of depression

affecting the nerve-centres—e.g. exposure to cold, alcoholism, &c.

Pathology.—Whether or not the process of urethral fever is primarily a neurosis set up by peripheral irritation, cannot yet be decided (*see* Surgical Fever); but this much at least may be said, that, whether true or not, this is a very good working theory, and treatment based upon it is safe and efficacious. The foregoing applies simply to those cases where a pyrexia, of varying degree, directly follows (as will be described presently) interference with the urethra, and where no complication from affection of other organs—e.g. kidneys, &c.—exists. But the operation of dilating a stricture is sometimes capable of producing intense congestion of the kidney, and frequently partial or complete suppression of urine. This effect on the secretory power of the kidneys finds a parallel in the rigor and pyrexia, being due to reflex disturbance of the spinal cord, &c.; and since this very awkward and frequently fatal complication possesses a like pathology to the pyrexia, &c., it may be partly averted in a similar way. As the result of a preliminary investigation, it may be stated that the actual change in the kidney-excretion in an ordinary case of urethral fever is very small, as regards the amount of water and of nitrogen. For the pathology of cases of suppression of urine the reader is referred to the article on that subject.

Post-mortem Appearances. — Urethral fever is very rarely fatal, and when it is so the result is owing to causes not yet explained, but connected with the sudden arrest of the renal secretion. Usually, after death the kidneys are found congested and the seat of old cirrhotic disease (interstitial), but nothing organic has yet been detected in the central nervous system.

Symptomatology.—Urethral fever presents itself clinically in two well-marked groups: one which may well be called fulminating, from the fact of its sending the temperature up to 105° F. within four hours, and another in which the rise of temperature is relatively slow, and often preceded by a depression due to shock. A distinct class of urethral fever, and one which scarcely merits the name, is that which is met with in the cases, referred to above, of suppression of urine after operation. Finally, there has been described lately a combination of these conditions and others, to which the name of catheter fever has been given.

(1) Fulminating Urethral Fever.—In this the most violent form, the temperature rises rapidly in four hours, on the average to 104°–105° F., and accompanying the rise of the pyrexia there are usually one or two severe rigors before it reaches its acme. The temperature commences to fall for two hours as quickly as it rose, but after that interval its descent is more gradual, and it reaches the normal again in about twenty to twenty-four hours. During its onset the patient feels sick and often has a violent headache, while during the rigor he suffers from the symptoms of that condition (*see* Rigor), but usually, soon after the temperature begins to fall the unpleasant symptoms gradually disappear.

(2) The second variety of urethral fever is characterised by a gradual rise to 101°–102° F., in about twenty-two to twenty-four hours, having been preceded for eight to ten hours by a fall below the normal level. The final fall of temperature from the acme is nearly equal in time to the actual rise—viz. about twelve hours, so that the whole course is of about thirty-three to thirty-six hours' duration. Rigors occur at the usual point in the rise of temperature, but are not so frequent as in the first variety, and the constitutional symptoms are not so severe.

(3) Urethral fever, occurring in cases which are attended with suppression of urine, must not be regarded as belonging to the same category of 'fevers' as the two first described, for the reason that the condition of the patient is not a simple one. In fact, it is impossible at present to distinguish what of the rise is due to the operative measures, and what to commencing interstitial nephritis, &c. As a rule, the temperature curve is that of continued fever, varying from 100°–102° F., and falling gradually for twenty-four to forty-eight hours before death, when it is frequently subnormal. The curve resembles that of traumatic fever far more than that of typical urethral fever.

(4) Catheter Fever.—Under this term, Sir Andrew Clark has drawn attention to the way in which urethral fever is frequently followed by septic infection. He divides the clinical history of these cases into four stages—(1) Reflex irritation of the nervous system (*see* foregoing remarks); (2) disturbance of general metabolism, especially in the kidney; (3) septic infection begotten autogenetically or deuterogenetically—i.e. inside or outside the body; (4) the effect in the vessels of the urinary tract upon the metabolic processes, produced by suddenly drawing off the water from a distended bladder.

In this article, the relation of urethral fever to subsequent fatal septic processes is not touched upon, on account of the fact that at the time when pure urethral fever is started by instrumentation, the introduction of septic material, which may or may not develop in two or three days in the bladder, is very likely to happen. Cases in which it does so are referred to under NEPHRITIS; PYELONEPHRITIS.

Between the varieties just described (excepting 'catheter fever') of fever following instrumentation of the lower urinary tract, there are transition cases which bridge over the intervals between the groups formed out of averages, minute differences of detail in treatment, constitution of the patient, &c., obviously affording reason for the multiplication of forms.

Prognosis.—Favourable, if secretion by the kidney is found to be undisturbed. Extremely unfavourable, in proportion to its development, if the secretion of urine is checked or diminished, with excessive blood-staining. More or less unfavourable if the temperature is not normal again in forty-eight hours, since a continuation of the pyrexia will then suggest the extreme probability of nephritis having been lit up.

Treatment.—The most successful treatment of urethral fever is that which is based on the neurotic theory. It has been known for a long time that quinine and morphia, administered prophylactically, prevent the development of fevers arising from many causes, and among others urethral fever especially. Before, therefore, a patient is operated upon for stricture, &c., he should be treated for two to three days with Quiniæ sulph. gr. iij., and Liq. morph. ℥v. every six hours. A quarter of an hour before the operation he should be given $\frac{1}{4}$ to $\frac{1}{3}$ gr. of morphia hypodermically, and be placed under ether for the operation.

During the operation he should be warmly clad, especially about the lower extremities, which are to be covered with drawers, socks, blanket, &c. In the event of a rigor, treatment indicated in the article on that symptom is to be followed.

Hot baths are of little use except in cases of SUPPRESSION OF URINE.

VICTOR HORSLEY.

URETHROPLASTY: shaping of the urethra. This term is used to denote operations for closing fistulæ or openings in the urethra. These operations may be practised in the perineal part, in the scrotal, or in the penile part of the urethra. They are most frequently needed to close gaps in the last portion, that being the common situation of the destructive action of sloughing sores, or the result of arrest of development during fœtal life. In the perineum, when obstinate fistulæ remain open, the tissues are nearly always greatly indurated and of low vital power; so that failure to get union of the margins of a fistula after bringing them together is very common, and several attempts must often be made before success is attained.

In all these operations, great attention to detail and most careful management are requisite. It is absolutely necessary that no urine shall percolate over the wound during the healing process. To ensure the preservation of the fresh wound from defilement with urine, the patient should be of an age when he may be readily taught to empty the bladder himself by a catheter, to be introduced every time urine is voided and before every evacuation of the bowels. This plan of preventing access of urine to the wound is much preferable to that of the retained catheter, by the sides of which the urine is apt to escape, when the instrument has been worn for more than two days. During the first twenty-four hours the catheter may be tied in, to allow the patient to recover his self-possession after the anæsthetic and for the soreness to diminish. But thenceforth the urine should be drawn every four hours by the patient himself. Should the patient be too young to be trusted with the catheter, it must be regularly drawn for him by a nurse, trained beforehand to use the catheter on the patient himself. While the catheter is worn, it should be plugged or its end connected with a foot or so of india-rubber tubing, so that the urine may be led away from the neighbourhood of the wound. It is also essential to success that the edges of tissue to be united shall be kept in close apposition without strain, that the circulation of blood through them may be free and continuous. If the circulation is hindered, either by dissecting too thin a flap of skin and thus dividing the nutrient blood-vessels, or by constricting them afterwards with tightly drawn sutures, the flaps do not unite, but slough away, leaving the opening larger than before.

Before operating, the patient must be prepared by invigorating his health with rest, attention to digestion, stay at the sea-side or in fresh country air, regular use of hip-baths, and thorough dilatation of a stricture if there be one in the urethra. Any impediment to the outflow of the urine, until the wound is firmly consolidated,

would drive the urine against the scars of the united edges and cause them to give way. When the patient is freed from irritation of all kinds, the operation may be undertaken.

When the fistula is situated in the perineum, before the incisions are made, a No. 20 or No. 22 (No. 12 English scale) flexible catheter may be passed to the bladder and tied in, being plugged after the urine has been withdrawn. Then, the track of the fistula should be thoroughly cleared of the old cicatricial membrane that lines it with a sharp scalpel, and the surfaces be brought into apposition as nearly as possible along their whole length, from the urethra to the skin, by the quill suture or the button suture. The edges should be closely united by fine catgut or silk stitches set near together. If there be tension on the stitches through the induration of the parts, the skin may be loosened by incisions carried parallel with, but at a distance from, the line of the closing edges. These parallel cuts ultimately close by granulations. The line of sutures may be protected with a coating of collodion, and then dressed with iodoform and iodoform wool.

In the scrotal portion incisions may be more freely practised; the edges, besides being thoroughly pared, should be dissected away in thick flaps, and their raw surfaces held in apposition over the gap by wire and button or clamp sutures, while their edges are closely joined with numerous fine sutures of silk. The sealing with collodion and the preliminary introduction of the catheter should be practised in these cases also.

In penile fistulæ or congenital defects of the urethra, the thinness of the tissues that can be used for closing the aperture requires very delicate handling and careful adjustment, lest the flaps that are formed by dissection be strained or so injured that they throw out no reparative material at their points of junction. Not infrequently only part of the gap is closed at the first operation, the remainder being united by one or more repetitions of the paring and stitching process. Should this be necessary, sufficient time—two or three months at least—should be given between each operation to enable the parts already joined to establish the circulation through a plentiful system of blood-vessels. If the second operation is undertaken too speedily, the flaps, being ill-supplied with nutrient vessels, will slough and probably undo some of the union already obtained.

Several operations have been devised for closing the gaps, but many of them are liable to the objection of producing a troublesome stricture. In those plans where the raw surface of the flaps is turned inwards at the part to be covered, this inner surface is slow to heal, and does so by granulation, cicatrisation, and contraction. The contraction must be kept open by sounds; the passage of which excites irritation and excoriation from time to time. This objection attaches to both of Nélaton's methods. By one of his plans the edges of the aperture are first pared, and then, transverse incisions through the skin having been made half an inch or more distant from the fistula—one in front, the other behind it—the knife is slipped underneath the skin, to separate it from the subjacent tissue, for half an inch all round the aperture. The skin which is thus freed is lifted away from the penis, and the edges of the fistula are drawn together by a pin and twisted suture. If the catheter be regularly employed and all urine drawn through it, the granulations growing from the large under-surface close the fistula in the urethra, and the gap in the skin unites quickly if not irritated by percolation of urine. The danger here is that the knife may be carried too close to the surface of the skin, and by dividing its blood-vessels, cause it to slough after the operation. Nélaton was also successful with another plan, by which, after paring the orifice, he dissected the skin freely around it by introducing the knife under the skin through two lateral incisions, parallel to and at some distance from the raphé; this done, he stitched up the orifice of the fistula in the area of skin separated from the cellular tissue, and passed a slip of india-rubber underneath it, to protect the joined edges from urine during their granulation, the urethral fistula being closed in the same way as in the first method.

The orifice which terminates the urethra before the operation is often extremely narrow; and before closing the gap, care must be taken to pare away the edges freely, to ensure a sufficiently wide passage at this point afterwards.

Legros Clark and others have devised, and used with success, methods by which flaps of skin dissected from the penis around the aperture have been securely adjusted over it, and union obtained. When the orifice is small, all these plans are successful, but when a large gap is to be covered, as in cases of hypospadias, they usually fail. Success has often followed the first attempt, if the precaution is taken to make a

perineal aperture in the urethra behind the fistula, through which the urine may be drained from the bladder until the plastic operations have thoroughly closed the fistula in front. When this repair is complete, the urine may be withdrawn through the natural channel, and the perineal outlet closes spontaneously.

In cases where the urethra is open quite or nearly to the peno-scrotal angle, the method devised by Anger of Paris has been successfully employed by the writer. In these cases, there is the additional complication of curvature of the penis during erection. Fibrous bands, placed across the corpus spongiosum near the urethra, prevent proper dilatation of the erectile tissue, so that the glans is bent during erection towards the scrotum instead of being directed upwards. In attempting a cure of such a case, it is necessary first to divide the fibrous bands which draw down the glans during erection, and when the wound thus made has healed, to proceed to the prolongation of the defective urethra. If the organ be examined, a furrow will be traced along the mesial line from the actual termination of the urethra to the apex of the glans. This is the roof of the urethra, in which, at the proper situation, the furrow is deepened to form the fossa navicularis. On each side of this furrow the loose skin of the penis is raised into a narrow ridge—each ridge being half of the raphé of the perfect organ. Anger, in order to provide a suitable surface for the continuation of the urethra, and also to prevent the formation of a cicatricial stricture, so cut his flaps that one was turned inwards, with its epidermic surface towards the urethra, its raw surface having been turned outwards. This raw surface was again covered by a second flap brought over it from the other side, and attached closely to it by rows of stitches applied on each side of the urethra, as will be presently described. By this contrivance a surface of skin, not raw tissue, was turned towards the urethra, and a large raw surface exposed and applied to a similar raw surface, to which it united by granulation. Great security against failure of union was thus obtained, and an epithelial lining provided for the urethra.

In carrying out this method, the penis is steadied on a large sound, No. 25 or 26, after the margins of the urethral orifice in front of the scrotum have been pared freely. One incision is made across the penis through the skin opposite to the glans penis, and, parallel to it, another three-quarters of an inch behind the orifice of the urethra. Between these transverse cuts two flaps are formed: one by an incision carried along the penis close to the raphé at the side of the furrow, and dissected outwards for half or two-thirds of an inch. This will form the outer flap when in position. Next, a parallel longitudinal cut is carried along the penis between the transverse ones, but two-thirds of an inch away from the mesial line. A flap is then formed by dissecting up the skin towards the raphé. When this flap is formed, it is turned over the sound, so that its epidermic surface lies against the metal. Its corners are then fixed by two points of fine catgut or silk suture to the raw surface of the penis, at each end of the root of the covering flap first formed. The two flaps are compared and, if needful, trimmed to fit nicely, especially at the posterior end, where they overlie the urethral orifice. The upper flap being then held back, a close row of fine silver wire sutures is carried through the free edge of the inner flap and the cellular tissue of the penis close to the root of the upper or covering flap, so as to attach the inner flap closely in its place, the ends of the wire being led out through the upper flap at its root and left loose. The upper flap is then applied to the inner one, and the wires tightened by running over them split shot or short lengths of lead-tubing, which can be pinched round the wires. The ends of the flaps are carefully stitched to the scrotum behind the margins of the orifice, and also at the end near the glans at each side of the sound.

Finally, the free edge of the upper flap is fixed in place by some points of interrupted suture along its free border. This done, the edges are freely painted with collodion; the sound is withdrawn and replaced by a flexible catheter, which is worn for the first twenty-four hours, after which time it should be taken out and the urine drawn off at regular short intervals during granulation. The parts must be kept well covered with iodoform and wetted with cold boracic acid lotion, to prevent erection during sleep. Erection may also be hindered by large doses of bromide or of bromide and chloral hydrate. The bowels must be kept quiet by opium, and the patient remain as still as possible in bed. At the end of the fourth or fifth day the sutures should be examined, and any that are cutting their way out removed at once, their punctures being drawn well together by collodion. In the course of seven or nine days the remainder of the sutures are removed, and at the end of a fortnight the

patient is able to sit up in bed and gradually resume his active habits. The catheter should be used for emptying the bladder for three or four weeks. *See* Hypospadias.

Berkeley Hill.

URETHROTOMY. — (Cutting the strictured part of the Urethra.) — The cases of stricture for which urethrotomy is most suitable are the following: strictures of the meatus urinarius; strictures of the penile portion of the urethra in front of the peno-scrotal angle, particularly narrow bands or 'bridle' strictures; strictures of the bulbous portion when composed of thick masses of fibrous tissue; and strictures of ordinary density, if dilatation by the passage of bougies or sounds excite irritation and febrile reaction in the patient.

In persons who suffer from rigors after a sound or bougie has been passed, complete division under anæsthetics commonly causes no rise of temperature and quells the irritation at once, if the precautions to be afterwards described are taken. Strictures which contract rapidly when enlarged by gradual dilatation are best treated by cutting; so also are strictures complicated with urinary fistulæ. Again, in young persons whose disease has not existed long enough to alter the condition of the kidneys, cutting is admissible for a stricture that should be simply dilated in an elderly man whose kidneys have undergone considerable degeneration. The young man desires to lead a more active life than he whose kidneys have been seriously diminished in excretive power can possibly do. Again, urethrotomy affords a longer interval of freedom from contraction than does any other plan of widening a stricture; and if the after-management of the stricture be regularly carried out—a necessity in all cases, whatever be the plan of treating the stricture—the patient may enjoy many years of freedom from disturbance of the urinary organs.

The patients for whom urethrotomy is not necessary or not suitable, are those whose contractions, being of only short duration, are formed by areas of inflammatory congestion rather than by development of fibrous tissue; such contractions are usually dispersed by gradual dilatation. Strictures also do not need urethrotomy which give way readily under gradual dilatation and do not contract again during the process, nor return rapidly after a sufficient width has been restored to the urethra. The result in such case is satisfactory, and obtained with less inconvenience by interrupted dilatation than by cutting.

Several methods are followed for treating strictures by cutting. They may be arranged in two groups—those which attack the stricture from within the urethra—*internal urethrotomy*; those which attack it from the surface of the body—*external urethrotomy*.

Internal Urethrotomy may be performed by instruments which cut the stricture as the knife advances along a guide towards the bladder, from before backwards; or, by one where the knife, protected by a shield, is first carried through the stricture, and then exposes its sharp edge to the stricture as the instrument is withdrawn from behind forwards. By cutting from before backwards narrower strictures can be divided than by the second method, where the instrument most generally employed for this purpose—Civiale's—cannot be used until the stricture is widened sufficiently to allow the knife and its shield to pass. The requisites of a urethrotome for cutting from before backwards are—(1) a guide through the stricture to the bladder, (2) a sharp edge, which, passed along the urethra under a shield, can be protruded by the operator at any part and as deeply as he desires to cut; (3) means for steadying and tightening the fibres to be divided before the knife is passed across them. The last requirement is an essential condition of a good urethrotome, in consequence of the toughness of the fibres themselves and the mobility of the parts in which they are formed; conditions that render proper division of them extremely difficult unless the part to be cut is kept taut while the sharp edge is carried across it. The edge of the knife also cannot be too sharp to divide the dense tissue of a stricture.

In the experience of the writer, Maisonneuve's urethrotome, as improved by Teevan, meets these requirements tolerably well. In the Maisonneuve-Teevan urethrotome, the guide consists of a fine, hollow staff, which can be passed through very narrow strictures by means of a filiform guide-bougie, to the end of which it can be screwed after the bougie has reached the bladder. Along the hollow staff a stylet is run, carrying in front of it a triangular shield, which, fine at the apex, widens gradually to three-quarters of an inch at the base. This inclined edge is pushed to the stricture at the upper surface of the urethra, tightening and steadying it before the triangular knife, which can be protruded beyond the shield, attacks the unyielding

fibres. When the opposing fibres are sufficiently divided, the shield travels onward to the bladder; and, in withdrawal, its wide base catches against any insufficiently divided fibres against which the knife's sharp base can be brought, and thereby ensures their thorough section.

Another urethrotome that complies with these requirements is the 'Wedge-Dilator' of the writer. It is composed of the following parts:—First, a narrow split sound, calibre of No. 8 of the millimetrical scale (No. 2 English), that can be guided through narrow tortuous strictures by being attached to a filiform guide-bougie, previously passed to the bladder. Second, a wedge that runs in dovetail grooves between the halves of the split sound. In this wedge is concealed a knife that can be protruded between the halves of the split sound, when the stricture-tissue prevents their separation sufficiently to allow the wedge to pass on. The wedge, pushed up to the situation of the stricture, in separating the halves of the split sound tightens and steadies the stricture thoroughly, while the knife divides it to the width required by the wedge to pass along. If a wedge be chosen that will expand the urethra to its full natural capacity, the cut made by the knife divides the stricture to that extent, but does not pass beyond the stricture into the vascular erectile tissue external to it. The knife can be applied either to the upper or under surface of the stricture as may be preferred.

Instruments which cut from behind forwards—i.e. after the knife in its shield has passed behind the stricture—steady the fibres to be cut by pulling forwards the parts which attach the urethra to the pelvis, as the bulbous end of the urethrotome is drawn out. The stricture is pulled on by the instrument until the cut gives free passage to the bulbous shield and knife, separated from each other. But reliance cannot be placed on the simple straining of these attachments to ensure perfect division of the stricture-tissue. A Civiale's, or any other urethrotome which cuts from behind forwards, is very apt to wriggle its way through a stricture without properly severing its fibres; and, to meet this difficulty, the knife is often carried more deeply than is otherwise necessary. There is another objection of greater importance to the method of cutting from behind forward. It is this: if an incision be made through a thin layer of fibrous stricture-tissue into the erectile tissue, in the belief that a tight stricture with a thick layer of fibrous tissue exists, there is greater danger of free hæmorrhage, and of septic absorption through the vascular tissue thus laid open. This risk is less when cutting from before backwards, and the writer prefers to begin at the meatus urinarius and divide only such obstructions as prevent the progress of the wedge-dilator in its advance towards the bladder, thus avoiding the risk of cutting into the erectile tissue.

Most of the instruments used for cutting from behind forwards consist of a straight or slightly curved staff, terminated by a bulb or 'swell.' This swell is the shield containing the knife. By means of a contrivance at the handle, the distance to which the cutting edge is thrown forwards from the shield can be regulated. The operator first passes the urethrotome through the stricture, then drawing the instrument outwards, exposes the knife at the posterior limit of the stricture, and with a slightly sawing motion cuts his way along the stricture. In doing this, he places the forefinger of his other hand against the skin lying over the stricture, and judges of the completeness of the division partly by the cessation of resistance to the progress of the knife, and also by the sensation which the near approach of the knife to the finger gives him. The success of the operation and the avoidance of dangerous complications depend greatly on the precision with which the fibrous tissue is divided and the normal vascular or erectile tissue outside it is untouched. Hence, by whatever method the cut be made, the operation is one requiring great nicety of manipulation and caution on the part of the operator.

Certain complications may follow internal urethrotomy if incision be carried beyond the fibrous tissue. Among them are perineal abscess, extravasation of urine, copious hæmorrhage, orchitis, acute suppurative nephritis, and septicæmia. But if the operation is confined to cases suitable for this method of treatment, and the necessary precautions are taken, the occurrence of dangerous complications is very rare. Before the patient is subjected to urethrotomy, his general condition must be free from febrile disturbance. The kidneys must be working properly; this is shown by the urine being acid, not much loaded with mucus, free from albumen or almost so, and containing urea in the proportion of not less than two and a half or two per cent. The urethra must not discharge pus; any urethritis that may be present must be cured before the operation is performed.

To ensure favourable results, the after-treatment is also of great importance. The writer's present custom, which he has followed for several years, is, after incising the strictures, to test the width of the canal by passing a wedge of the size of No. 27 of the millimetrical scale after the knife, and then to withdraw, by a No. 24 silver catheter, any urine that may be in the bladder. No catheter is tied in the urethra, and the patient is ordered to refrain from micturition for seven or eight hours, or as long as the call is not urgent. The secretion of urine for some hours after the operation is small because, to prevent vomiting from the anæsthetic, the patient has fasted for five hours before the operation, and after it takes only a few spoonfuls of ice or iced milk for a like period. In six or eight hours the wound is protected by firm clot and plastic fibrin. When the bladder must be emptied, the patient is put into a hot hip-bath, and passes urine while in the bath. The urine is thus voided without spasm of the perineal muscles ; and the incision, protected by clot and fibrin, is not torn open and exposed to the stream of urine. If the urine flow off without disturbing the protecting clot, very little if any pain is felt during micturition and no reaction ensues. If pain has been felt, it is well to repeat the hot bath at the second act of micturition.

The nurse should be directed to take the temperature of the patient before he passes urine, and at half an hour and an hour afterwards. In the cases of reaction after micturition, the thermometer will show a slight rise before the patient feels any malaise, chill, or shiver. Immediately a rise is detected, a soothing draught or antipyretic should be given, such as twenty minims of tincture of opium in an ounce of brandy and a little hot water, into which five or eight grains of quinine are put. The temperature must be carefully noted every two hours, and an important elevation combated by repetitions of the quinine at intervals of three hours. But, if precautions are taken to prepare the patient for operation and to avoid strain of the urethra in micturition during the first twenty-four hours, reaction seldom occurs, and the temperature keeps below 99° F. throughout.

It is indispensable that the patient lie in bed continuously for at least ten days, and keep his room for fourteen days. He must not even get up to the night-stool for the first three days after the operation. To conform to this condition the more easily, the bowels should be well cleared before the operation and the patient lightly fed afterwards, that the bowels may not need to be cleared for three or four days. At the end of this time a dose of castor-oil or blue pill and draught of sulphate of magnesia may be taken, to ensure defæcation taking place promptly and without straining. On the eighth or ninth day a bougie, No. 24 or 25, should be slowly and gently passed through the stricture, no instrument having been introduced after the operation until then. This period of rest to the incision is of the highest importance to avoid pain, bleeding, and suppuration of the wound. If the wound heal by suppuration, the after-contraction is always much more speedy than when it heals by simple union. On the tenth or eleventh day, the patient may be taught to pass the bougie himself by letting him push it slowly and gently to the bladder. A repetition of this lesson on the thirteenth day usually suffices, and the patient is allowed to get about at the end of the fortnight. If pain and soreness attend the passage of the bougie, the temperature must be carefully watched, as was done after the operation. On the approach of pyrexia, warm baths, fomentations, &c., must be employed to allay local irritation, while the febrifuge draught is again prescribed. Before leaving the surgeon's care, the patient must be impressed with the necessity for regularly passing the bougie at intervals increasing in length from twice weekly to once in three months or once in six or twelve months, according to the rapidity with which signs of shrinkage come on.

Dangerous Complications. — Copious hæmorrhage is most frequent immediately after the incision, if the knife have cut more than the stricture itself; but it may occur at the end of a week after incision, even before a bougie has been passed. In such cases the knife has been carried too deeply, and the erectile tissue has been wounded. It is rarely dangerous, and is controlled by passing through the stricture a lithotomy tube or one made of hard rubber, around which the urethra can be compressed, and the bleeding vessels closed till a coagulum is formed, when the compressing apparatus may be removed. When the bleeding point is at the bulbous portion of the canal, a crutch, invented by Otis of New York, can be fastened to the knees and ankles, and made to press strongly on the perineum. Renal congestion, denoted by rigors, diminished secretion of urine, &c., may follow the incision itself, or may occur if a bougie be incautiously thrust through the granulating

area of the wound. The most common consequence of too hasty a use of the bougie is epididymitis. Nephritis and septicæmia are treated in the manner appropriate to these affections when arising from other causes. Perineal abscess and extravasation of urine require early drainage and great cleanliness in dressing. It must be again repeated that, when sufficient care has been taken in the preparation of the patient and in the performance of the operation, these complications do not occur.

For widening very narrow, tortuous strictures, along which a bougie or catheter can be passed only part of the way, or when the presence of a narrow anterior stricture hampers the surgeon in the treatment of a second deeply placed one, Lund of Manchester has invented a useful instrument. A grooved and very narrow director projects for two and a half inches beyond a cylinder of the size of No. 20 of the millimetrical scale. This director is passed as far as it will go through the stricture, and then a stylet, carrying a little knife that projects one-twentieth of an inch above the director, is thrust forwards from the cylinder by a thumb-spring in the handle. This cuts the anterior stricture sufficiently to allow an instrument to traverse it and approach the deeper one with freedom. This plan is occasionally a useful resource; but it needs great care and nicety in execution, that the instrument may not enter a false passage, and incise that instead of the urethra.

When the stricture is very dense and of long standing, the bladder is sometimes so affected with chronic cystitis that nothing except the restoration of free evacuation will cure it. But the trickling of pus, often of ammoniacal urine also, over the fresh wound of the incision excites irritation and suppuration therein, with unfortunate effect on the stricture. A procedure revived by Reginald Harrison of Liverpool is very useful in these cases—drainage of the bladder through a perineal opening into the urethra behind the stricture—so that no urine, pus, or mucus shall pass over the stricture-incision until it has had time to heal.

External Urethrotomy, dividing the stricture from without, is practised upon a guide passed through the stricture to the bladder—Syme's operation. When it is not possible to pass a staff to the bladder, the stricture may be reached by opening the urethra in front of it, laying bare its mouth and passing fine directors through it, on which the knife which divides the fibrous tissue can be guided along the urethra—Wheelhouse's operation. Lastly, it may be dealt with by opening the urethra behind the stricture—Guthrie's perineal section—and cutting forwards through the stricture to a sound passed down to its anterior end.

The cases for which external division is appropriate are those in which the perineum is thickened and hardened by inflammation or cicatrices, and the urine escapes, wholly or in part, from the dilated urethra behind the stricture through one or more fistulæ. The very rare cases, also, in which repeated patient trials fail to introduce an instrument along the urethra to the bladder, must be treated by a perineal opening.

Syme's operation; or that in which a grooved staff can be passed through the stricture to the bladder. The staff used in these cases has at the last three inches—the curved part—the calibre of No. 8 of the millimetrical scale (No. 2 English). This part is grooved on the convexity; beyond the grooved part to the handle, the staff enlarges by an abrupt shoulder to No. 18 or 20 (No. 10 to 12 English), and the groove is prolonged by a notch through the shoulder, but no farther. This staff is passed into the bladder, and the patient is put in the lithotomy position. The surgeon sits down opposite the perineum, and, with the left forefinger inserted into the rectum, feels for the curve of the staff in the perineum, and also that its position in the urethra is correct. An assistant holds the staff steadily, pushing its convexity downwards towards the surface, that it may be the more easily met by the knife. The surgeon then introduces the point of a scalpel, the cutting edge being held forwards, through the skin and fat at a point one inch in front of the anus and exactly in the mesial line of the body. The left forefinger then explores the incision for the staff; if felt, the finger is held steadily against the staff while the scalpel is slid along the nail till its point penetrates the urethra, which is usually not indurated at this part, and rests against the staff in its groove, the edge of the knife being forwards as before. The knife, steadied by the left forefinger behind it, is then carried forwards, the point scraping along the groove of the staff until the shoulder of the staff is reached. The whole of the indurated tissue of the stricture being cut, the knife is laid down and a small gorget with a narrow tapering point, fine enough to run in the groove of the staff, is passed through the wound to the bladder. When this is reached by the gorget, the staff is withdrawn and a flexible or celluloid catheter, No. 20 or 22

(No. 12 English), is passed along the urethra from the meatus, and, guided by the gorget, traverses the incised part of the urethra, and easily reaches the bladder. The gorget is removed, the catheter secured, and the bladder emptied. The catheter is worn three days, then withdrawn, and a No. 24 or 25 steel sound is passed every third or fourth day until the perineal cut has closed. Fistulæ, if tortuous or containing collections of pus, must be incised, that the matter collected in them may drain off freely. Usually, when urine is no longer forced into them by the efforts of the patient to empty the bladder, fistulæ close up readily.

It is necessary that the patient be aided in his recovery by rest in bed, good food, sea air, &c., as the bodily condition is often much exhausted by irritation of the stricture and the abscesses which formed before the operation was performed.

A stricture divided externally will, if neglected, shrink again as certainly as it does after any other method of treatment. Hence the patient must be trained to use a maintaining bougie regularly after he is dismissed from the surgeon's care.

External urethrotomy by opening the urethra in front of the stricture, now generally practised by *Wheelhouse's method*, is a very valuable one in the rare cases when, though urine escapes along the urethra, no instrument can be passed through the stricture. The patient is put into the lithotomy position; a straight staff, grooved on one side, with its beak turned up as a blunt hook at the other side, is passed along the urethra to the stricture, and held steadily with the groove directed towards the surface. The operator feels for the tip of the staff, and, making in the mesial line an incision an inch long through the integuments, exposes the tip of the staff at the bottom or posterior end of this incision. He then completes the division of the urethra for the length of the incision, by running his knife along the staff. The sides of the incision are seized with hooked forceps and held asunder by assistants, and the staff is turned round, that its hook may catch in the upper end of the incision. The interior of the urethra is carefully sponged and the mouth of the stricture sought for. It is usually discovered easily, and a fine probe-pointed director may be carried through the stricture to the bladder. On this director the stricture may be cut towards the bladder with a long narrow knife or tenotome. When the passage has been thus widened, a small tapering gorget, of which the beak fits into the groove of the director, is carried to the bladder. The director is withdrawn, the hooked staff and forceps are removed, and a flexible catheter, passed along the urethra, is guided to the bladder by the gorget and fixed in place. The remaining treatment is that employed in Syme's method.

Perineal Section of the membranous portion of the urethra must be done when no guide can be carried to the bladder. By this operation access is obtained through a cellular interval between the last portion of the rectum and the bulb of the urethra. Here, in the mesial line of the body, no important structures intervene between the urethra and the surface. The patient is directed to hold his urine, if possible, for some hours before the operation, that the bladder may be charged and its neck and the distended membranous portion of the urethra found more easily at the time of operation. The surgeon has at hand a bistoury, probes, probe-pointed directors, artery-forceps, sharp and blunt hooks, No. 20 (12 English scale) silver catheter, tapering gorget, sponges, tapes, &c. The patient is put into the lithotomy position, and the surgeon begins by passing the left forefinger into the rectum to ascertain the precise position of the bowel, and to draw it slightly backwards. A puncture through the skin, half an inch in front of the anus and precisely in the middle line of the body, is made with a small sharp-pointed bistoury, the edge being turned forwards, and an incision is carried directly forwards for an inch and a half. When the skin of the perineum is much indurated, a short transverse cut may be made also to give freedom to the further steps of the operation. With this exception, the line of the cut must be carefully kept in the mesial line throughout, or the urethra may be missed and much mischief done. The left forefinger being still in the rectum, the incision is deepened to one inch. If the patient cough or strain, the urethra may often be distinguished when distended by the escape of urine into it from the bladder; in this state its puncture is easy. If the urethra remain collapsed, the point of the knife is thrust backwards a little and the patency of the urethra tested by a probe, and by the left forefinger exploring the wound. If urine escape through the puncture, difficulty is at an end. A director is passed to the bladder and along it the tapering gorget, over which the urine escapes copiously. The track to the bladder being thus assured, the stricture may be dealt with.

A catheter is passed along the urethra from the meatus to the contracted part, and then the gristly tissue is cut cautiously, in a forward direction from the incision, until the catheter can be brought to the surface of the gorget, by which it is at once guided into the bladder, where it may be tied in and the gorget withdrawn. Sometimes when the urethra has been opened behind the stricture, a fine probe or probe-director can be carried from the posterior incision forwards through the stricture, and the division of the stricture by means of its guidance is much facilitated. Cases of traumatic stricture occur, in which the induration of the perineum by cicatricial tissue extends as far as the neck of the bladder, access to which can be obtained only by slow penetration with repeated cautious cuts in the middle line, until a probe or director can be carried into the bladder, when the division of the stricture may be performed in the way already described. In these cases care is necessary to avoid the rectum in the progress of the knife to the neck of the bladder. Usually, the hæmorrhage is not great, because the naturally vascular structures have been replaced with fibrous tissue. After the operation, the patients recover slowly with a urethra that is very prone to shrink, so that the daily use of the sound or bougie is usually needed to keep it open.

Subcutaneous Urethrotomy is a term applied to division of short ring-like strictures in the penile portion of the urethra. A small grooved staff, straight and about six inches in length, is passed through the stricture. The staff and penis are well steadied by an assistant while the operator, passing a fine sharp-pointed tenotome through the skin and stricture to the staff, carries its point up and down until the stricture is thoroughly divided. The little skin-puncture is then sealed with collodion ; a No. 16 (No. 8 English) catheter is passed to the bladder and worn for twenty-four hours to prevent the flow of urine into the cut for that space of time. The external aperture having healed, the catheter is withdrawn and the urethra left at rest for six or seven days. At the end of a week, the dilating sound, No. 24 or 25, should be passed every third day for some weeks until the incision has healed. This method of cutting strictures has been applied to the treatment of long and deeply placed ones ; but its success has been doubtful in such cases. When employed for short penile strictures, it has proved a very simple and successful operation. Berkeley Hill.

URETHRO-VAGINAL FISTULA.

See Vaginal Fistulæ.

URINARY DEPOSITS.— The substances which form urinary deposits in health make up, when exaggerated in quantity (and others added), the sediments of disease. In forming a list, therefore, it will be best not to regard this or that deposit as notably pathological or the reverse, but to arrange them according to their composition, and as to whether they are deposited from neutral, acid, or alkaline urine.

Thus, the following *simple*, *unorganised*, *chemical substances* are deposited from—

A. Neutral Urine.
   1. Oxalate of lime.

B. Acid Urine.
   2. Uric acid.
   3. Urates.
   4. Oxalate of lime.
   5. Tyrosin.
   6. Cystin.

C. Alkaline Urine.
   7. Ammonio-magnesic phosphate.
   8. Magnesic phosphate.
   9. Phosphate of lime.
   10. Urate of ammonium.
   11. Carbonate of lime.
   12. Oxalate of lime (if alkalinity is weak).

1, 4, 12, *Oxalate of lime*, appears as a slight white sediment in urine of persons apparently healthy, especially in the tropics (India, &c.). *Tests*—(*a*) Microscopic : Seen as octahedral crystals, rarely spheres, dumb-bells, and prisms ; (*b*) Chemical : Insoluble in acetic, soluble in hydrochloric acid. *Importance*—Slight, usually due to vegetable diet ; may, however, be a symptom of general metabolic derangement known as the oxalic acid diathesis.

2, *Uric acid*, appears usually as a brick-red sandy deposit, which clings to the bottom of the vessel, and has long been known as the ‘ lateritious deposit.’ *Tests*—(*a*) Micro. : Seen as ‘ whetstone ’ crystals usually, the shape being made more characteristic if the acid is allowed to recrystallise from its solution in a drop of hydrochloric acid ; frequently the bright-red crystals form great rhombic bundles, in which the whetstone outline is more or less lost ; (*b*) Chem. : Heat *gently* in a capsule with a drop of nitric acid until a solid residue remains, which, moistened with a drop of ammonia or other alkaline solution, gives a purple or blue colour (murexide). *Importance*—Considerable if present in quantity, a symptom of so-called uric acid diathesis ; is an indication of (1) great tissue-waste, (2) excessive

ingestion of nitrogenous food, (3) imperfect elimination of nitrogen by excretory organs.

3, *Urates*, usually of soda, more rarely potash, for urate of ammonium see below; appear as a white or pink light precipitate, falling as the urine cools. *Tests*—(*a*) Micro.: The heavier urates are frequently amorphous, and so are seen as fine granules which form earthy masses; sometimes, rarely, they crystallise as rhombic needles; (*b*) Chem.: Soluble on warming; dissolve in acid; obtain uric acid test, for which see above. *Importance*—Same as uric acid; *see* above.

4, *See* 1.

5, *Tyrosin*, forms a greenish-yellow precipitate if present in quantity. *Tests*—(*a*) Micro.: Seen as sheaves of needles, rarely in spheroidal masses; (*b*) Chem.: Scarcely soluble in hot water, soluble in alkalies. If the watery solution is boiled with a little Millon's reagent (mercuric iodide dissolved in potassic iodide), the fluid becomes dark red, and a red precipitate falls. *Importance*—Great, as indicating usually acute atrophy of the liver, and, at any rate, great tissue-destruction, since it appears in the tissue in extreme cases of smallpox, typhus, and phosphorus-poisoning. Under these circumstances, it is accompanied usually by leucin, which may share in producing the above-mentioned deposit, and which is recognised, at any rate, by its microscopical characters of colourless spheres of colloidal appearance.

6, *Cystin*, a rare substance, and which, when present in urine, seldom produces a definite deposit, but colours the urine a greenish-yellow. *Tests*—(*a*) Micro.: Seen as colourless hexagonal plates, not to be confounded with *yellow* hexagonal plates of iodoform; (*b*) Chem.: Cystin is precipitated from its solutions as white crystals, which are soluble in ammonia and recognisable under the microscope. *Importance*—Only as possibly leading to the formation of calculi.

7, *Ammonio-magnesic Phosphate.*—This salt, the well-known triple phosphate, is of the greatest clinical interest, forming a white deposit from ammoniacal urine. *Tests*—(*a*) Micro.: The crystals of this salt form regular prisms with trough-like ends (coffin-lid crystals), which form masses in the urine, entangled in mucus, &c.; (*b*) Chem.: The crystals are soluble in acetic acid, &c., but their form is sufficient for diagnosis. *Importance*—The formation of this deposit in the bladder or on the surfaces of wounds made for opening that viscus, when the urine is ammoniacal, leads to the production of thick coatings of friable deposit, held together by mucus. These coatings may assume the proportions of calculi, and produce similar symptoms.

8, *Magnesic Phosphate*, a white salt found with No. 7, forming a floccular sediment. *Tests*—(*a*) Micro.: Seen as rhombic plates under the microscope; (*b*) Chem.: These crystals gradually dissolve in a 20 per cent. solution of commercial carbonate of ammonia, whereas the triple phosphates are unaltered.

9, *Phosphate of Lime.*—(1) The tribasic salt forms a green iridescent scum on the surface of urine (and calculi—Shattock). *Tests*—(*a*) Micro.: Seen as crystalline plates; (*b*) Chem.: Soluble in acetic acid (*see* No. 7) without effervescence. (2) The neutral calcium phosphate forms rosettes of needles or pointed rhombic prisms.

10, *Urate of Ammonium*, is mixed with the phosphatic deposits from ammoniacal urine. *Tests*—(*a*) Micro.: Seen as spheroidal crystals furnished with spikelets; (*b*) Chem.: Soluble in potash with evolution of ammonia. Urate detected as above; *see* No. 3.

11, *Carbonate of Lime*, mixed usually with the earthy phosphates (*see* No. 9). *Tests*—(*a*) Micro.: Usually seen as spheroidal masses, especially in presence of any colloid substance; (*b*) Chem.: Easy to detect by the effervescence on adding acetic acid to the *crystals* under the microscope.

To the above list may be added as a rare curiosity *sulphate of lime*, occurring as a white deposit in acid urine. *Tests*—(*a*) Micro.: Seen as acicular crystals and colourless prisms; (*b*) Chem.: They resist the action of weak acids.

So also *hippuric acid* may occur as a deposit. Care must be taken, of course, to note whether the patient is taking an excess of benzoic acid as food or medicine. Hippuric acid forms a crystalline sediment like the triple phosphate. It is soluble in hot water, and, being dried after treatment with nitric acid, gives a strong smell of nitrobenzol.

The remaining deposits for consideration are those which are formed by portions of the tissues of the urinary tract.

1. *Epithelium.*—Epithelial corpuscles of the urethra, bladder, ureter, and renal pelvis, and of the renal tubules, may be found distinct or massed together, and always possessing more or less characteristic shape, which enables them to be recognised as coming from a definite part of the tract. As a rule, the epithelium is undergoing fatty and granular degeneration, the

nucleus being obscured. It is customary to describe the masses of corpuscles which are derived from the renal tubules as casts, and then to classify them into—(*a*) blood-casts, (*b*) hyaline casts, and (*c*) epithelial casts. This is a practically useful division, and therefore is best retained, it being understood that no special means of production is assumed thereby.

a. Blood-casts are simply small clots expelled from the tubules, and we may find in other kinds of casts numerous red blood-corpuscles.

b. Hyaline casts are clear albuminous moulds of the tubules. How they are formed is a matter of theory, but as they are albuminous they may simply be coagulated exudation, or albuminoid material the result of albuminoid degeneration.

c. Epithelial casts—i.e. shedding of the epithelium of the tubules—may take place in parenchymatous diseases of the kidneys to such an extent as to occur in masses in the field of the microscope. Usually the masses are very degenerate, and often the outlines of the corpuscles are all fused together. The relation of the above-described casts to the various forms of kidney-disease is fairly constant, and, from what has been said, it will be understood that the desquamation of more or less perfect epithelial casts will occur in parenchymatous nephritis, that blood-casts will be seen in acute nephritis, and that fatty and hyaline casts accompany chronic disease.

2. *Mucus* is always present, more or less, as a tenacious cloud settling to the bottom of the glass; it may occur in such quantity as to form a thick ropy mass filling half the vessel. Microscopically it contains numerous 'mucus' corpuscles.

3. *Pus*, recognisable as a yellow, ropy sediment mixed with mucus. Microscopically, the fattily degenerated leucocytes, with breaking-up nuclei, are very characteristic. Chemically, the addition of potash makes the sediment excessively ropy, sticky, and sometimes lumpy.

4. *Semen*.—All the constituents of semen may occur in the urine after emission, &c. Thus, fully formed spermatozoa, spermatoblasts, and colloidal spheres have all been found, and are easily recognisable.

5. *Fragments of New Growths*.—Occasionally, portions of tumours of the urinary tract are found in the deposit. The commonest condition in which this occurs is a villous tumour of the bladder. A portion of the vascular stroma covered with epithelium may be detected by patiently searching the deposit, and especially if any fibrinous shreds are to be seen in it. A shred of villous tumour is so characteristic as not to require detailed description. Next, epithelioma of the bladder may be discovered by finding quantities of greatly degenerated and distorted large epithelial cells, such as obviously come from the bladder. The diagnosis is here much more difficult, but a very accurate surmise can be made by a practised eye. Lastly, epithelial growths, cancers, &c., of the kidney shed typical cells (usually with blood-clots), and sometimes have thus confirmed a diagnosis.

Vegetable Parasites.—All kinds of fungi have been described as occurring in normal urine, but very grave doubt is always to be cast on such statements. There is only one condition known, and that imperfectly worked out, in which organisms (vegetable) have been found in acid urine. Roberts has described a form of bacilluria in which bacilli (resembling B. subtilis; *see* SCHIZOMYCETES) have existed in the healthy bladder during life. Passing from this point, it is, of course, a matter of every-day observation that all kinds of organisms—micrococci, bacteria, termo, &c.—grow readily in alkaline urine, and, by keeping up fermentation, cause the deposit of numerous salts.

Animal Parasites. — Among urinary deposits must be mentioned the ova of the Bilharzia worm, which has its habitat in the portal venous system, and which causes hæmaturia. The ova are found entangled in the deposits of blood-clot.

General conditions, such as chyluria, &c., which cause partial deposits, are not properly treated of in this article. *See* URINE.

VICTOR HORSLEY.

URINARY FISTULA in the perineum commonly results from abscess, caused by urethral stricture in the ways described under PERINEAL ABSCESS. When abscess is the preliminary stage of the fistula, the collection of matter may communicate from the first with the urethra, or may form outside and open into the urethra afterwards. When the suppurating tract has no external opening it is termed a 'blind fistula.' Besides origin in the urethra, fistula may be caused by abscess in the prostate, by sloughing of the integuments over areas invaded by extravasated urine, or by the destruction produced by venereal sores. Again, fistulæ remain sometimes after lithotomy or cystotomy, from the knife having been carried too deeply into the rectum (recto-vesical or recto-urethral fistula). Or,

a piece of calculus or other foreign body lodged in the urethra may set up abscess that terminates in fistula. Fistulæ are produced sometimes in the loin in connection with the kidney. *See* NEPHROTOMY.

Fistulæ usually open in the perineum near the scrotum, in the scrotum or sheath of the penis, but they may also terminate in the groin, above the pubes, at the nates, or in the upper part of the thigh. Usually limited in number to one or two, they may be numerous, even as many as fifty. Their orifices are commonly only the size of pinholes; but, where there has been sloughing from extensive extravasation of urine, large gaps may be left by necrosis of the soft parts. The urine may escape during micturition as a drop or slight oozing from one or two of the orifices, or most of it may be voided through several openings, and trickle away like water through a colander.

The varieties of fistula may be arranged in four groups.

1. *Simple fistulæ*—that is, one or two canals running from the urethra to the surface, and affording a tolerably direct channel for the outflow of urine, when the urethra is blocked in front of them by a tight stricture.

2. Fistulæ which permeate a perineum indurated by long-continued suppuration of the cellular tissue and skin, underneath which are cavities filled with a mixture of pus and urine, and where the fistulæ wind in devious tracks.

3. Fistulæ which remain as unhealed tracts after the operations of lithotomy or cystotomy, reaching as far back along the urethra as the prostate; or fistulæ which are kept open by the lodgment of fragments of calculi or other foreign bodies escaping from the bladder. These fistulæ often open into the rectum instead of at the surface of the perineum.

4. The last variety comprises fistulæ where wide gaps have been produced by sloughing of the walls of the urethra and overlying integuments.

The course of a urinary fistula is always from bad to worse, so long as the obstruction which caused it remains; the passages become more numerous, the abscesses in their course larger and deeper, the strength of the patient is steadily sapped away, and cystitis from continuous retention of urine in the bladder adds to the patient's sufferings. Further, the kidneys undergo chronic interstitial nephritis, and in time lose much of their secreting tissue. Hence, urinary fistula, in addition to being a cause of constant suffering and pain, is a danger to the life of the patient. In those cases where no impediment to the flow of urine exists with the fistula, as in fistulæ produced by sloughing, the patient's health recovers though the unnatural gap or channel remains unclosed, and he suffers only from deformity, or from the inconvenient exit through which his bladder is emptied.

Treatment.— It will be seen that of the foregoing varieties of fistula the great majority are caused by stricture; consequently, one main requirement for the cure of fistula is to open up the natural passage for the urine. In simple fistulæ, where there has been an abscess of limited extent and the perineum is not indurated beyond the area of the abscess, dilatation of the stricture to its normal width by the interrupted passage of bougies or by internal urethrotomy (*see* STRICTURE OF THE URETHRA), thereby restoring the flow of urine to the natural channel, is often sufficient to cause speedy closure and consolidation of the fistula. But care must be taken to keep open the dilated stricture by the regular passage, at short intervals, of a bougie of large size (No. 24 or 25, French scale). When, in addition to simple obstruction, abscesses or pouches filled with urine and pus have formed along the course of the urethra, or there are more than two passages from the urethra to the surface, simple dilatation or internal division of the stricture is not sufficient; a more direct escape must be provided for the contents of the suppurating cavities. External division is necessary, in order that not only the urine, but also the infiltrating contents of the passages and cavities, may be thoroughly drained away.

In such cases, perineal section is usually performed by one of the following methods. When a Syme's grooved and shouldered staff can be passed along the urethra, the incisions are most conveniently made with its guidance. When a staff cannot be passed through the stricture, the straight staff of Wheelhouse should be carried as far as the stricture, to serve as a guide for the boutonnière incision for exposing the anterior extremity of the stricture. *See* BOUTONNIÈRE. By this means a fine probe and grooved director can be passed through the stricture to the bladder, and the stricture itself thoroughly divided before the fistulæ are laid open and drained. It may happen that, even in the simplest cases, the maintenance of a free passage for the urine along the urethra does not altogether prevent the escape of a few drops into the

fistula at every act of micturition. This small quantity of urine is sufficient to keep up irritation and prevent the closure of the fistula. To overcome this difficulty, the urine must not be allowed to flow at all along the urethra. It must be withdrawn from the bladder through a catheter. If this is done, the walls and the fistula soon granulate and shrink together until thoroughly consolidated. To provide for the removal of urine by catheter, the patient must be trained to pass one himself on every occasion when it is needful to void urine.

By regulating the diet, removing all stimulants therefrom, and limiting the quantity of liquid imbibed, it is seldom necessary to pass a catheter more than thrice, or perhaps twice daily. The urine should always be withdrawn before defæcation, lest straining of the levator muscles drive some drops of urine into the urethra. The catheter should not be tied in the urethra; but withdrawn after each act of micturition. Experience shows that, if a catheter is constantly in the urethra, that canal soon widens or relaxes around it, and the urine not only escapes through the catheter from the bladder, but also by the side of it, and so easily finds its way into the fistula.

Even when great care is taken to maintain a free channel for urine along the urethra, and to prevent its entry into the fistulæ, the latter sometimes refuse to heal. If so, they should be carefully examined for the presence of pouches or blind alleys charged with pus. If any are found, they must be opened and drained. If, on the other hand, no such cause of delay is discovered, and the fistulæ are simply indolent, cicatrisation may be expedited by injecting them regularly with astringent lotions, by irritating them with the galvanic cautery, or with a probe armed by fusing on its tip a globule of nitrate of silver.

For the rectal fistulæ left after lithotomy, the patient should keep the prone position continuously for several weeks, so that the urine may be driven as little as possible against the floor of the bladder and prostate, through which the fistula passes. The gap may be encouraged to shrink and close, by burning its edges from time to time with the galvanic cautery, or, if a very wide gap, the edges may be pared with the knife and brought together with sutures, in a manner similar to that for closing a vesico-vaginal fistula.

The general health is often much broken down in cases of severe stricture and fistula. This must be improved by rest, tonics, and nutritious food.

The last variety—cases where large gaps in the wall of the urethra and integument have been left after sloughing action—are often difficult to treat. Those behind the scrotum usually contract and close in time, if the stricture be kept carefully dilated. Those in the penile portion need plastic operations for their cure; such are fully described under URETHROPLASTY.

BERKELEY HILL.

URINE, Morbid Conditions of the, in relation to Practical Surgery.—The importance of the urine in so-called 'surgical' cases, and the points which should be particularly noted by the practical surgeon, will be best described and understood by detailing the conditions met with in clinically examining the urine in such cases, by noting at the same time the pathological products in the same, and by stating what are the causes of their appearance.

The systematic observation of the urine, in the way described below, will not, of course, be necessary in its entirety in every case, but the main points at least must be carefully investigated (e.g. the presence of albumin, sugar, &c.) before any active surgical treatment is ever commenced.

It may be as well here to draw attention to the salient clinical points to be observed in the act of micturition itself, since these depend partly upon the condition of the urine (i.e. quantity, &c.), as well as upon that of the excretory organs; and the relation between the matter excreted and the process of excretion is so intimate that they cannot practically be separated. Following the scheme originally suggested by Sir Henry Thompson, we shall arrange the facts for this purpose under the headings of—(1) frequency; (2) difficulty; (3) pain; and simply tabulate in two columns the causes which produce the abnormal symptoms—viz. those which are directly exciting from changes in the urinary apparatus, and those which arise from the condition of the urine.

Frequency.—As a preliminary, it should be noted whether the frequency is abnormally marked by day or by night or both; since it is obvious that a simple local condition like vesical calculus will, when the patient is up and about in the daytime, give rise to great irritability, which subsides to a large extent when he is at rest at night. And this properly brings us to note that, while, of course, the fact of a patient micturating at night is, under any circumstances, to be regarded as of importance, it must not be forgotten that persons vary in their habits, and that the habit of rising

in the very early morning to micturate is not very uncommon among people in good health; and the same influence of habit, too, determines differences in the number of times a patient micturates during the day.

			1. *Due to changes in Urinary Apparatus, direct or indirect.*	2. *Due to changes in the Urine, direct or indirect.*
Frequency	Increased	A. With increased flow of urine	Polyuria: Lesion of cerebrum? / Lesion of medulla oblongata (including cerebellum)	
			Diabetes mellitus.	
			Contracted kidney.	
			Cystic ditto.	
			Tubercular ditto.	
			Albuminoid ditto.	
			Febrile polyuria after the crisis.	
		B. Without increased flow of urine	Stricture of urethra.	Decomposition.
			Prostatic disease.	
			Cystitis.	
			Tumour of bladder.	
			Calculus in ditto.	
			Tumour of kidney.	
			Tubercle of ditto.	
			Calculus in ditto.	Calculous deposit.
	Diminished	Without diminution of flow	Any degree of retention due to prostatic or urethral obstruction.	
		With diminution of flow	Fatty kidney.	
			Final stages of albuminoid and contracted kidney.	

From the foregoing table the conditions which lead directly to an increase or decrease in the quantity of urine excreted are visible at a glance, and also the relation they bear to the process of excretion, or, in other words, their clinical symptomatology. We will, therefore, rest contented with noting, later on, one or two facts concerning the quantity of urine excreted, and meanwhile briefly refer to the questions of difficulty and pain in the act of micturition, in so far as they depend on morbid states of the urine. For physical changes in the urinary tract, reference must be made, of course, to the special articles on the organs involved. *See* Stricture; Prostatic Hypertrophy.

Difficulty of micturition from the state of the urine may be caused by plugging of the canal by—(1) calculus; (2) blood-clot; (3) portion of new-growth; (4) excessive quantity of ropy mucus (urine alkaline, &c.).

Pain in micturition due to the state of urine may be caused by—(1) excessive acidity (especially noticeable if any part of the passages is congested); (2) passage of calculi, clots, fragments of growths, crystals (urate of ammonia), gravel.

Since the foregoing facts concerning micturition have been detailed as far as they are connected with the morbid conditions of the urine, we can now note systematically the changes which arise in the condition of the urine in disease, and especially with reference to surgical practice. The order followed is that one which is found most useful clinically — namely, quantity; smell; reaction; colour, including blood; specific gravity; urea (*see* special article Urea); albumin; sugar; chyle; fat; urinary deposits and crystals. *See* Urinary Deposits.

Quantity.—The quantity of urine excreted by a healthy person in full exercise is, clearly, very different from the amount secreted by the same person at rest in bed, and this difference is not always adequately discounted in clinical observation. In the first place, it may safely be laid down that the quantity excreted varies nearly directly with the quantity ingested, and, consequently, a person confined to bed not infrequently excretes only 25 to 30 ounces in the twenty-four hours. Further, this quantity will vary with the amount of excretion of fluid by the bowels and skin, one compensating for the other.

In the foregoing table, showing the conditions which produce increased or decreased frequency of micturition, those which influence the quantity excreted are also classified, so that reference is here directed to the list there given. It only remains to observe that, between a slightly diminished flow and complete Suppression of Urine, a condition of inadequate excretion or oliguria may result, which usually terminates fatally from uræmic poisoning.

Smell.—The smell of urine is a valuable mode of investigating its condition, since all fermentative changes reveal themselves

at once, especially the ordinary ammoniacal destruction of the urea, &c. The normal urinous odour appears to vary in degree with the amount of nitrogenous solids in the urine; but this correlation can only be accepted as the very roughest estimate, and the more especially since it is not at present determinable what substance produces the odour. It need hardly be said that observations made on the smell of urine are of value only when the urine has just been passed or drawn off with a catheter. Artificial odours of all kinds may be produced by drugs.

Very rarely, sulphuretted hydrogen, H_2S, gives its characteristic odour to the urine. In the majority of cases it has simply been absorbed into the circulation from a foul abscess, usually connected with the bowel. It may arise, too, from the decomposition of pus in the urine.

Reaction.—The normal acid reaction of the urine, while of value in resisting the invasion of that fluid in the bladder and kidneys by putrefactive organisms (which of course require, in the large majority of cases, an alkaline pabulum), nevertheless varies greatly in degree, the person being still in apparently perfect health—thus urine may be weakly acid, neutral, or really alkaline. Diet is the main causative agency determining these differences; a nitrogenous flesh diet causing greater acidity, and vegetable food, on the other hand, producing alkalinity; but a distinctly alkaline non-decomposed urine must always be regarded suspiciously, until proved to be otherwise normal. Thus, for instance, the urine has frequently this reaction in diabetes.

In cases where the acidity of the urine aggravates symptoms—e.g., those of gonorrhœa, granular urethritis, &c.—it is easily made alkaline, and therefore non-irritating to the inflamed mucous membranes. Conversely, it is made acid by the administration of mineral acids. It may not be out of place to refer here to the former attempts to effect the prevention, if not the solution, of renal and vesical calculi by altering the reaction of the urine. Although the treatment of the various calculous deposits is now entirely directed into operative channels, it is still desirable to point out that distilled water is of great value in aiding the natural solution of acid salts in the tubules of the kidney, and that by this simple method a valuable flushing out of that organ is obtained.

Colour.—The normal colour of the urine is interesting from the very important point of view of its origin. That it is derived from the hæmoglobin of the blood is probable, but the process of formation of the pigment (urobilin) is absolutely unknown, and reference must be made to text-books for discussion of this point. Pathologically, the colour of the urine may be altered as follows:—

1. *Diminution of Colour.*—Every degree of paleness may be found in urine in proportion to the increase in the watery constituents, the solids remaining the same. Diminution, however, of the normal pigment may occur without increase in the watery excretion. This diminution of pigment is found in connection with general failure of pigment-formation in the body—as in cases of anæmia, albuminoid disease, &c.

2. *Increase of Colour.*—The urine may be 'high-coloured,' as it is termed, from an increase of tissue-metabolism and excretion of solids; and, in cases where this condition has been produced by pyrexia, a red colour is seen to be added to the urine, being produced by a pigment which has been termed 'urerythrin,' but which is perhaps only an altered condition of normal urobilin.

3. *Additional Coloration.*—(*a*) The urine may be coloured from a dusky red to a dark brown from the presence of blood. *See* Urinary Deposits; Hæmaturia.

Further, similar colour is produced by hæmoglobin—that is to say, methæmoglobin—when that form of the blood-colouring matter is found dissolved in the urine without a trace of red blood-corpuscles. In some cases the amorphous red deposit, found in the urine, has been taken for hæmatin. And this condition, under which the colouring-matter is excreted apart from the corpuscles, has been termed hæmatinuria; but spectroscopic examination shows that, in the large majority of cases, the substance is methæmoglobin, and the condition, therefore, should be known as hæmoglobinuria. It is scarcely necessary here to do more than point out the great importance clinically of recognising this state of things in cases of hæmaturia, and, further, that a leading characteristic is its proclivity to be paroxysmal, and that each paroxysm is evoked by cold and nerve-fatigue.

Detection of methæmoglobin is rendered easy by—(1) the fact of the colour being present in the absence of corpuscles; (2) the characteristic spectrum; thus, the urine being *perfectly fresh*, there will be seen a band in the red between C and D, together with the ordinary bands of oxy-

hæmoglobin on the green side of D, while no broad absorption from E to F is seen, such as is produced by hæmatin.

The accompanying table may be of value in estimating the clinical import of the occurrence of blood in the urine :—

Condition of the mixture of blood and urine	
1. Completely mixed. (Note that the blood-discs are mostly broken up, and that blood-casts are common.)	Acute congestion (idiopathic and reflex action of drugs). Pyelitis (acute septic). Embolism. Tubercular disease (usually pyelitis). Traumatism (*vide infra*). Renal calculus. „ tumour (especially carcinoma). Acute specific conditions (scurvy, blackwater fever, &c.).
2. Incompletely mixed (i.e. usually numerous clots). (Note that the blood-discs are mostly unaltered, and that casts are rare.—Salkowski u. Leube.)	Renal traumatism (laceration, gunshot wounds, &c.). Renal tumour (portion of growth may be entangled in clot). Rupture of bladder. Cystitis. Vesical calculus. Vesical tumour (blood usually expelled at end of act of micturition). Portion of growth may be entangled in clot.

It is, of course, to be remarked that the above table only represents the commoner conditions under which blood occurs as such in the urine, and that the distinction drawn between the degrees of mixture and the presence or absence of clots is to be regarded as liable to frequent exception. Within reasonable limits, however, the above facts will be found to hold good.

Of course, no mention is made here of bleeding from the urinary passages after micturition. *See* URETHRA, Diseases of the.

(*b*) Bile-pigments are commonly present in the urine in cases of jaundice (obstructive) as a dark brown coloration, which is due to all forms and derivations of bilirubin, and easily detected by Gmelin's test of the play of colours produced by the addition of nitric acid.

(*c*) Melanin. This substance, the pigment of melanotic tumours, is occasionally found in the urine of patients suffering from that form of new-growth. It is usually brought out by the action of oxygen, either by exposing to the air or by oxydising reagents, such as nitric acid.

(*d*) Indigo occasionally appears in the urine in excess, and is of especial interest to the practical surgeon from two points of view. In the first place, its precursor, indican, is excreted by the kidneys whenever the substance indol, which itself is the precursor of indican, one of the putrefactive results of pancreatic digestion, is absorbed (and formed) in quantity by the small intestine. The circumstance of practical interest under which this occurs is that of acute obstruction of the small intestine. Occasionally, the indigo may reveal itself by its colour when the urine is allowed to putrefy with exposure to the air, but, as a rule, it is necessary to mix the urine with an equal quantity of hydrochloric acid, and then to add a very little chloride of lime, when the well-known colour of indigo-blue appears, and may be dissolved in chloroform. More frequently we have seen the colour to be a red purple from the formation of indigo-red, &c. There is no doubt whatever that this reaction is useful as an aid in determining whether the obstruction, in a given case, is affecting the large or small intestine.

The second point of interest is that, as discovered by Dr. Ord, it is possible for an indigo calculus to be formed, although, of course, this is very rare.

(*e*) The above rarer pigments have been described before reference is made to the black colour produced in urine by the action of carbolic acid, because they are mostly exaggerated amounts of derivatives normally produced by tissue-metabolism, whereas, of course, the colour produced by carbolic acid is almost always an artificial effect. Although phenol compounds have similarly been found to occur in the urine as the result of absorption by the small intestine of some of the katalytic products of its action, still the coloration of the urine by carbolic acid usually means its employment in excessive quantity as a therapeutic agent. The well-known black brown coloration of the urine is produced by oxydation of hydrochinon, which is the form in which the phenol compounds appear in the urine. The hydrochinon is at first present as a colourless sulphate, which splits up, and the hydrochinon becomes oxydised to a brown product. A parallel substance termed brenzcatechin by Baumann, which also darkens on exposure to the air, is a phenol derivative belonging to the aromatic series.

Having discussed the preliminary points to be observed—viz. the quantity passed, the smell, reaction, and colour—we will now briefly consider the solids found as pathological constituents in the urine, it being remembered, of course, that many of these occur under normal conditions of

health, and that it is their exaggeration or diminution which brings them into the following category. The points to be observed are arranged in the order of their practical importance.

Specific Gravity.— The estimation of the specific gravity is of some value, when the quantity of urine excreted is known, as indicating the amount of solids present; but variations, not exactly commensurate with increase in weight of the solid constituents, occur when the specific gravity is raised by the presence of sugar, albumin, &c., an average normal being 1020.

Urea. *See* UREA.

Albumin.—In the very large majority of cases the albumin, which appears in the urine as the necessary result of destructive degenerative conditions attacking the glomeruli, &c., of the kidney, is serum albumin, pure or mixed with serum globulin, and as such is detected by the now classical methods of heat, acidification, picric acid, Oliver's test papers, &c., for details of which the manuals of urine-testing may be consulted. The quantitative estimation, however, deserves especial attention, as being a factor of great moment in deciding the practicability of surgical operative procedures in a patient suffering from this, the ordinary form of albuminuria. A rough estimate of the amount passed may be made by taking a sample of the whole twenty-four hours' urine, precipitating the albumin, and allowing the precipitate to settle for twenty-four hours. The latest form of this method (Esbach's) consists in perfect precipitation with picric acid, and collection of the urine and precipitate in graduated tubes. The more elaborate results, obtained by weighing the dried mass obtained from the total twenty-four hours' urine, are to be relied on only where very accurate work is required, but a sufficiently good clinical result will be obtained by the above simple methods of allowing the precipitate to settle. The influence of the albuminous urine on polarised light is also made use of in estimating the amount of albumin more or less accurately. Before alluding to the practical importance, in clinical surgery, of correctly estimating the occurrence and degree of albuminuria, it will be better to tabulate the kinds of albumin known with certainty to be excreted pathologically, and at the same time to note the conditions of such excretion. The fact, however, that albumin in the form of egg albumin, or albumen, when taken in excess by way of diet will appear as such in the urine (having escaped digestion by reason of its quantity), is first to be thought of in seeking for a cause in any given case of albuminuria; and further, it is to be remembered that, in a certain proportion of people who are apparently in fair health, albuminuria may appear in an intermittent or paroxysmal form, the exciting causes of which are very obscure.

The following list gives the various kinds of albumin producing the condition of albuminuria:—

Albumin.		*Causation of Abnormal Excretion.*
1. Serum albumin (and serum globulin).	*a.* Renal vascular changes	Arterial blocking (vasomotor ?). Venous obstruction (pressure of tumours, &c.).
	b. Renal parenchymatous changes	Acute inflammation (simple or septic). Hyperæmia, &c., in fevers of severe and continued type. (This includes all specific diseases, zymotic and septic.) Chronic nephritis. Chronic interstitial ditto (granular contracted kidney). Albuminoid degeneration. Pregnancy.
	c. Injuries, &c., of the nervous system	These probably are indirectly through the vasomotor system for the most part, but possibly also of course by direct action on the kidney.
	d. Drugs	All violently acting substances, which increase renal secretion.
2. Hemialbumose (halfway substance between albumin and peptone). Determinable by clotting in the cold after urine has been boiled with HNO_3 and filtered hot.		Osteomalacia (Bence Jones). Urticaria (Salkowski). Hæmoglobinuric condition (Neale).
3. Peptone. Determinable by precipitation by tannin, phosphomolybdic acid, and by giving a red violet colour when mixed with alkaline copper sulphate solution. If albumin is already present, it is got rid of by treating the urine with acetate of soda and ferric chloride, boiling and filtering.		Occurs when general metabolism is much disturbed, as in phosphorus-poisoning and in profuse suppuration. *See* ALBUMINOID DEGENERATION.

The clinical importance of albuminuria, in its relation to practical surgery, will be seen from the foregoing table to narrow itself to two distinct issues. In the first place, the condition indicates general depression of metabolism both primary and

secondary, and therefore, if general operative measures are in any way contemplated, their performance should depend entirely on the amount of albumin daily excreted on the one hand, and the urgency of the operation on the other. Further, a prognosis as to the chance of the wound healing, the recovery from shock, &c., must also be determined simply by the degree to which the albuminuria extends, compared with the general physical condition of the patient. In expressing these very general conclusions, it is to be understood that the kidneys are supposed diseased in any of the above-mentioned ways, except that by albuminoid degeneration. In this last condition several cases have from time to time been recorded with indubitable accuracy, where there was albuminuria coupled with the other signs of the disease, and yet where recovery has followed even such an operation for complete removal of the diseased part as amputation through the hip-joint. The second point is much more important—namely, the question how far it is advisable to operate upon the urinary tract, where there is coexistent albuminuria. Under the heading URETHRAL FEVER will be found described that condition of the nervous system which is excited by operations on the urethra; the reflex congestion of the kidneys which follows such interference, in a large proportion of such cases, must of course demand special attention when the kidneys are already so degenerated as to admit of the excretion of albumin. As a rule, the precautions described in the article referred to will prevent an untoward result if the albuminuria is slight, such as not infrequently accompanies severe strictures. As most operative measures on the urinary tract, however, are surgical necessities, the fact of coexistent albuminuria will not usually weigh much with the surgeon in deciding what to do, but it should count very heavily in the formation of a prognosis. Indeed, for such a prognosis, the degree of albuminuria must, other things being equal, be regarded as the factor of first importance. *See* ALBUMINURIA.

Sugar.—Of the utmost importance to the practical surgeon is the occurrence of glycosuria, for not only has he then to do with a disturbance of the proper storage and metabolism of the carbohydrates in the body, but, also, has to take into account the great derangement of the general metabolic processes which follows as a secondary result of the circulation of sugar as such, and which is revealed by the clinical observations of emaciation and the often greatly increased excretion of urea. The causes of glycosuria, where the sugar is dextrose, may be tabulated as follows:—

Action of—	
1. General causes	Pregnancy. Suckling. Over-feeding.
2. Lesions of the nervous system	Injuries of the medulla oblongata and base of the brain and cervical spinal cord. Hæmorrhage into parts of the cerebrum. Concussion, with laceration of the brain. Meningitis. Tumours of the base of the brain.
3. Specific diseases	Malaria, cholera, diseases of the liver, diseases of the heart and lungs which produce congestion of the liver—e.g. chronic lung-diseases and tricuspid incompetency.
4. Drugs	Chloral, chloroform, ether, alcohol, amyl nitrite, morphia, curare, &c.

The detection and estimation of the sugar, by means of Fehling's solution, is too well-known to need repetition here. We, therefore, shall pass on to glance at the general effect on the system which is produced by glycosuria, and which necessitates great alteration in the surgical treatment of disease. In the first place, as just remarked with reference to albuminuria, and hinted at in explaining the increase of urea excreted in this disease, the general degeneration of the tissues will render it of course highly advisable not to perform any operation, unless absolutely or urgently necessary, upon a diabetic patient. It is this degeneration of the connective tissues, of the skin, &c., which easily leads to suppuration, boils, &c., commonly attacking these patients. The transitory glycosuria which occasionally attacks members of a glycosuric family, and senile glycosuria also, must be distinguished from the ordinary fatal disease, diabetes, in forming any such conclusions as that above indicated. Very rarely, sugar of muscle, inosite, has been found in the urine.

Chyle.—In chyluria the urine contains a white albuminous fluid, which forms a sort of sediment, partly composed of small cells, &c. In chyluria the coexistence of albumin and fat is of importance, as sug-

gesting at once the true nature of this condition; but it is impossible to confound it with that seen (rarely) after fractures of bones (so-called Lipuria, *vide infra*), the milky emulsion showing that the fluid in the urine is chyle, and not the mechanical mixture of oil and urine about to be described. How the lymphatics come to discharge their contents into the urinary passages is unknown; but both in India and in England (in persons who have been abroad), the *filaria sanguinis hominis* worm has been detected in the blood, apparently possessing a causal relation to the condition. In many cases, however, this factor is apparently wanting, and its pathology remains obscure. Chyluric patients are, by reason of the direct interference with the absorption-power of the lymphatic system, specially bad subjects for surgical treatment. *See* Chyluria.

Fat, or excretion of fat, will readily occur under mechanical conditions which liberate it from its normal position, such liberation being effected by traumatic means. This is not the place to describe in detail the pathology of fat-embolism; but in very severe crushing fractures, where a quantity of bony cancellous tissue, medulla, &c., is injured, as e.g., at the lower end of the femur, fat is occasionally absorbed (of course as oil), and has produced embolism in the lungs, &c. That it should be excreted by the kidneys is not surprising, and more than one author has detected the fat on the surface of the urine. This, however, is not the experience of English observers, and it is yet doubtful how far the kidneys can excrete the fat in such cases. *See* Fat Embolism.

The causes of fat (as such) being present in the urine are—

1. Traumatism of bones.
2. Phosphorus-poisoning.

Very rarely cholesterin has been found in the urine (Salkowski).

Victor Horsley.

URINE, Retention of. *See* Retention of Urine.

URTICARIA (*Synon.* Cnidosis; Nettle-rash).—An acute or chronic disease of the skin, characterised by the appearance of wheals on any part of the cutaneous surface, including the scalp, and occasionally on the mucous membrane of the mouth and throat. Wheals, which are pathognomonic of urticaria, are due to acute circumscribed œdema of the skin, and vary much in size and appearance. They may be no bigger than a split pea, or as large as an egg or more, and sometimes, when closely placed or confluent, may occupy a large tract of the skin (urticaria conferta). Their colour varies with the amount of hyperæmia by which they are accompanied; they are vivid pink, or of a paler red tint, which is not uncommonly limited to the margin of the wheal, the central part being of a bright whitish-grey (U. porcellanea); sometimes the whole wheal is white, and is seated on faintly erythematous, but otherwise normal, skin. They are circumscribed, and project above the surface to a varying extent, being nearly always flattened; but in some cases they are accompanied by œdema of the subcutaneous areolar tissue, and are then not only of large size, but very prominent (U. tuberosa; giant urticaria). When they are situated on parts in which the skin is loose (eyelids, prepuce, scrotum), they give rise to much diffused swelling. In shape they are rounded or oval as a rule, giving rise by confluence to the most various gyrate and map-like figures, but often form prominent streaks, straight or irregular in course. Sometimes, the amount of serum poured out in a wheal is so great as to raise the epidermis in a bleb (U. bullosa), or congestion is so extreme that rupture of capillaries may occur, blood being poured out into the skin (U. hæmorrhagica; purpura urticans). The one character which is common to them all is their evanescence; they appear suddenly, and after lasting a short time (a few hours at most), disappear completely with equal suddenness, leaving absolutely no trace of their existence, the skin on which they were seated returning to a perfectly normal condition, except when vesication or hæmorrhage has occurred.

Wheals are due to a great variety of causes, but in order that these should be efficient there must be a specially irritable skin, or idiosyncrasy, in the affected persons; for, of many subjected to the same conditions, by no means all get urticaria. When this irritability is extreme, simple friction by rough clothing, as flannel, is enough to produce wheals, and they can always be evoked by rubbing with a blunt instrument or scratching (U. factitia). Contact with aniline dyes, exposure to cold, and electrical stimulation, will also produce wheals on specially sensitive skins. All diseases of the skin in which there is much itching are very liable to give rise to urticaria, as scabies, phthiriasis, eczema, prurigo; further, the more direct irritation of the bites and stings of insects, fleas, bugs, gnats, &c., and contact with nettles, may

give rise to more or less extensive outbreaks of wheals. Indirect causes of urticaria are very numerous; the more important are—(*a*) irritation of some part of the mucous membrane of the digestive, urogenital, and perhaps respiratory tracts; thus, outbreaks have been observed to follow dentition, the passage of gall-stones, puncture of hydatid cysts of the liver, intestinal worms, the application of leeches to the os uteri, menstrual irregularities, miscarriage and asthma. (*b*) Certain diseased conditions have been noticed to be frequently accompanied by urticaria; for instance, jaundice, diabetes, Bright's disease, ague, rheumatism and typhoid fever. (*c*) Various articles of food are among the most frequent causes: chiefly shell-fish—as crabs, lobsters, and mussels; eggs, mushrooms and cucumbers; raw fruit—especially strawberries and currants—and various other substances, in specially susceptible persons. (*d*) Many drugs have occasionally given rise to urticaria: as copaiba, cubebs, turpentine and essential oils, capsicum, santonin, chloral, morphia, and salicylic acid. The three last-mentioned groups probably give rise to urticaria owing to the circulation of abnormal materials in the blood. (*e*) Lastly, urticaria may have a purely neurotic origin; it has been noticed to alternate with or replace neuralgia; and mental excitement, the passions of anger, fright, and grief are sometimes the starting-point of severe outbreaks.

Urticaria is doubtless to be looked upon as an angio-neurosis, an irritation of the terminations of sensory nerves in the skin and mucous membranes being followed by reflex spasm of the arterioles in the affected part, and this, again, by paresis, leading to congestion and serous effusion. Accordingly, the microscopic appearances of a wheal are mainly œdematous swelling of the rete Malpighii and of the corium, with a slight accumulation of leucocytes in the latter around the blood-vessels, which are dilated and full of blood at the margins of the wheal, the central parts being anæmic owing to pressure of the effusion; the lymphatic vessels of the part are also dilated and full of corpuscles.

Urticaria consists essentially in the appearance of wheals, which have been already fully described; but the following varieties may be noticed, as their symptoms differ to some extent.

1. Acute Urticaria.—This form is often accompanied by a rise of temperature, preceded by languor, chilliness, &c.; sometimes the fever is very high (U. febrilis), and there may be delirium. The patient is much distressed by sensations of burning, tingling, or itching, which are soon followed by a copious outbreak of wheals, generally affecting a large part of the cutaneous surface, and accompanied by much erythema; when the face is affected much disfigurement results from general œdema. In this severest form of urticaria, which is fortunately rare, the mucous membrane of the mouth, fauces, and pharynx is often implicated; the tongue, uvula, and soft palate become much swollen, and swallowing is rendered difficult. Dyspnœa often is present, especially when the larynx is involved; notwithstanding the severity of the general symptoms, the fever is sometimes very slight. The onset is very sudden, and, happily, subsidence also, a few hours to a few days bringing the attack to an end. The commonest cause of this variety appears to be a severe mental shock; but errors in diet, of the kinds already enumerated, not infrequently give rise to a severe general urticaria (U. ab ingestis), which runs a very rapid course, and may be at an end in a few hours (U. evanida).

2. Chronic Urticaria.—An acute attack, however, not uncommonly passes into a milder condition, without fever, in which wheals continue to appear from time to time on various parts of the body, and this state, with remissions, may continue for weeks, months, or years. The remissions, though usually distinct, are sometimes so slightly marked that there is a practically continuous production of wheals; which, however, retain their distinguishing characters of abrupt appearance and subsidence and short duration (U. perstans; urticatio). This condition is the cause of much suffering to the patient, and may give rise to anæmia and weakness, sleep especially being much interfered with. It has, on rare occasions, been followed by blotchy pigmentation of the skin.

3. Urticaria Papulosa (Lichen urticatus).—This variety is confined to children, and usually occurs in those who are out of health and weakly, but is now and then met with in the robust. It is characterised by the appearance, chiefly at night, of pale red wheals, varying in size from a finger-nail to an almond, scattered over the trunk and extremities, most plentifully on the former. The wheals subside, but leave behind them small pale hemp-seed-sized papules, which are more permanent, lasting several days; these are due to effusion of lymph, and are undoubtedly produced by scratching, as they are found excoriated or

with minute adherent blood-crusts, are intermixed with scratch-marks, and differ in no particular from the precisely similar papules which are met with in scabies, phthiriasis, and prurigo. The disease is very obstinate, and resists treatment, especially when it cannot be associated with digestive derangement, dirt, and bad hygienic conditions.

4. Urticaria Pigmentosa.—This name is given to an extremely rare affection, of which about twenty cases have been described. They all occurred in children, the age of onset varying from a few days to six months; the general health was usually good; the duration of the disease always very long, lasting for years. The lesions met with are of two kinds: (*a*) flat, pigmented, more or less erythematous patches of varying size, not raised, scattered over the whole surface except the palms and soles, most numerous and largest on the trunk; the erythematous patches are constantly the seat of fugitive wheals. (*b*) Raised, pigmented nodules, which are permanent; the distribution is the same. The pigmentation in both varies from buff to light brown, and the wheals, although met with in both, are most characteristic of the first form. The permanent pigmented nodules, although they may occupy the site of wheals, are no longer to be included in this category; they last for many years, and are richly infiltrated with cells.

Diagnosis.—The diagnosis of urticaria need give rise to no difficulty, if it be remembered that wheals are the essential mark of the disease, and that these, however various in aspect, size, and distribution, are invariably characterised by abrupt appearance and subsidence, and by evanescence; further, that itching, stinging, and tingling are prominent symptoms in urticaria, and are absent, or only slight, in other affections to which it bears a superficial resemblance. When the face is attacked, and especially if there be high fever, the œdema of the eyelids and general swelling may be so considerable as to produce a close likeness to erysipelas; the rapid evanescence, the large cutaneous area simultaneously affected, the absence of spreading at the margin, and subsidence without branny desquamation, will be sufficient to distinguish it. The red rash which accompanies acute urticaria may be mistaken for scarlatina; but its occurrence on the face, its more sudden onset, the intense itching, and the absence of the characteristic throat and tongue of scarlatina, are sufficient distinctions, even without the characteristic wheals. Some gyrate and annular wheals are like the lesions of certain varieties of erythema multiforme; but in the latter we have a characteristic localisation, a darker red colour, a greater permanence, and much less itching. The large swellings of erythema nodosum are not unlike the wheals of urticaria tuberosa; but here also localisation, permanence, absence of itching, and especially the characteristic bruise-tints during subsidence, will easily clear up the case. The bullous form of urticaria is not likely to be confounded with pemphigus, if it be borne in mind that in the latter the bullæ appear in successive crops, and are mostly seated on skin which is in all respects normal. Only a careless observer can take the chronic, unchanging, pigmented maculæ and nodules of urticaria pigmentosa, unassociated as they are with any other lesion—except wheals, for infantile syphilis.

Treatment.—The treatment of urticaria resolves itself into discovery of the cause, and its removal when possible; when this cannot be done, the results of medication are often very unsatisfactory, although great improvement may be nearly always obtained and the distress relieved by palliative measures. When the wheals are due to scabies and pediculi, these parasites must be destroyed by the usual methods; the irritation caused by the bites of fleas, bugs, and gnats should be met by removal of the cause when possible, and by the application of a lotion containing bicarbonate of soda, or of sal volatile. If eczema be present, that must be cured first, and, when it is at an end, the urticaria will probably not require much further treatment. The other sources of external irritation, rough flannel in contact with the skin, stuffs coloured with aniline dyes, or even badly-fitting undergarments, which are likely to cause friction especially at the root of the neck, across the shoulders, and around the waist, should be carefully looked for, and rectified when found. The dress of urticarial patients should be neither too light nor too heavy, since both heat and cold are likely to be injurious; for this reason they should avoid crowded hot places, as theatres, and sleep in a cool room, with light bedclothes.

If no external cause can be discovered, we must inquire into the condition of the internal organs, more especially the alimentary canal, and it is here that the irritation which is reflected upon the skin will be very frequently met with; if it be found that any of the articles of food already specified have been recently taken, or that any drug has been administered likely to

cause an outbreak of wheals, these should, of course, at once be stopped. The attack itself is best treated, if seen early, by a quick emetic, such as sulphate of zinc or mustard, and a brisk purge, more especially if the mucous membrane of the mouth and throat be affected; if there is much fever, an antimonial saline will be beneficial, or the administration of alkalies and diuretics, together with fluid food, may be sufficient. When there has been much antecedent dyspepsia, this should be treated carefully, and the diet must be regulated; of course all the articles likely to cause urticaria must be forbidden, and, in addition, coffee, pungent condiments, and stimulants should be excluded; but it is necessary to study the idiosyncrasy of each patient with regard to food, as perfectly harmless substances, such as milk or eggs, will often cause urticaria in the specially predisposed. When tænia or other intestinal worms are present, they must be treated by appropriate means. Locally, lotions may be employed to allay the itching, the best being one of carbolic acid (1 to 40 or 60) or chloral (gr. x. ad f℥j.); alkaline and starch baths are also useful. If the urticaria occurs in association with menstrual irregularities in anæmic and hysterical women, iron is especially indicated, and arsenic is occasionally of value in small doses; but these cases are often obstinate and difficult to treat. When the affection appears in the course of acute disease, as rheumatism and typhoid fever, it requires no special treatment beyond a little soothing lotion, and will subside of itself when the illness which it complicates is at an end.

The same rule applies to cases occurring in association with chronic disorders, as Bright's disease and diabetes; but here, as the irritation is due to the circulation in the blood of abnormal materials which are a necessary concomitant of an incurable condition, it is obvious that amelioration only can be looked for, the urticaria improving *pari passu* with the general health. An acute urticaria due to mental shock will subside of itself, and requires no special treatment beyond a day or two's rest in bed; possibly, a saline purge may be required. Where a purely neurotic urticaria is of intermittent type, quinine, especially combined with hydrobromic acid, and arsenic are indicated; in other chronic neurotic cases much difficulty will be encountered, and the drugs recommended are so numerous that it is plain that all are often unsatisfactory. The following may be tried: Salicylate of soda, tincture of cannabis indica, tincture of belladonna, and bromide of potassium; atropin by the mouth, in doses of 1 to 2 milligrammes (about grain $\frac{1}{100}$ to $\frac{1}{50}$) per diem, has lately been much praised; it is also necessary in these cases that all dietetic and hygienic precautions should be taken, and good results have been stated to follow change of air and scene.

In the treatment of urticaria papulosa, hygienic measures are of the first importance; without cleanliness, pure air, good food, and suitable clothing, but little progress can be made. When these conditions are favourable, treatment should be directed to improving the digestion, which is nearly always faulty, the urine being often loaded with urates, and the stools deficient in bile or otherwise abnormal; a mixture containing bicarbonate of soda in some aromatic water, with or without bismuth, to which bromide of potassium may be added, and occasional doses of grey powder or rhubarb and soda will be found beneficial; while anæmia and debility are best treated by cod-liver oil and iron. If intestinal worms are present, treatment should be directed to their removal. Locally, weak alkaline baths, followed by inunction with oil or vaseline, may be recommended, and, in very chronic cases, an ounce of potassa sulphurata may be added to the bath; if the itching is extreme, a lotion of carbolic acid or some other antipruritic may be used. It should be remembered that the affection is very obstinate, and liable to relapse under any treatment. JOHN CAVAFY.

UTERINE APPENDAGES, Removal of the.—The position of the patient, of the tables, and of the instruments, spray-producer, &c., are exactly the same as for OVARIOTOMY, and need not be again described. The opening in the macintosh sheet which covers the abdomen should be long and narrow: long, because if it be found advisable to remove the tumour a long incision will be necessary; and narrow, to expose as little of the abdominal parietes as possible, so as to avoid chill during the operation. In addition to the instruments required for ovariotomy, a couple of Kœberle's serre-nœuds which have been for some days in carbolic oil (1 to 20), several wires of different lengths and sizes, a pair of special forceps for tightening and cutting the wire, and a strong nickel-plated corkscrew should be at hand. The Nélaton forceps and the vulsellum will not be wanted, and need not be placed in the trays.

An incision three inches long should first be made, so that the hand can be introduced

and the position of the ovaries and tubes and their relation to the tumour ascertained. If the size and nature of the tumour be such as to afford a good prospect of cure from the removal of the appendages, and the relations of the latter to the tumour such that they can be cleanly and safely removed, they should be dealt with just as in OVARIOTOMY and OÖPHORECTOMY; but special care must be taken not to puncture any vessels in transfixing, because it is much more difficult always, and often quite impossible, to apply a fresh ligature on the proximal side of the puncture to stop hæmorrhage from it. Both sides should be securely ligatured, and any sponging of the peritoneum completed before the appendages are cut away, and it is advisable to leave the stumps a little longer than in oöphorectomy.

Supra-vaginal Hysterectomy.—If hysterectomy be decided upon, the incision should be prolonged to the left of the navel, so as to allow the uterus, with tumour and appendages, to be brought out without undue bruising of the edges of the incision. The raising of the mass is often very difficult, especially if it be wedged or adherent in the pelvis; the extraction will be made much more readily if a strong broad-bladed corkscrew be screwed into the fibro-myoma, to serve as a handle to lift it out of the abdominal cavity. Abdominal adhesions should be separated and secured as far as possible before the extraction, and it is much more often advisable to divide them between two forceps or two ligatures than in ovariotomy, the solid tumour allowing hæmorrhage more readily than the collapsed cyst-wall.

As soon as the tumour is extracted, its base must be carefully examined to see whether the appendages can be included in the wire; in some cases it will be better to transfix the broad ligaments and tie them off separately, applying the wire round the uterus where the broad ligaments are cut on each side, or even transfixing the ligaments on each side with the wire. The relation of the bladder to the uterus in front must also be carefully defined before the wire is tightened, and it will often be necessary to make a transverse incision just above its vesical fundus and peel it back, so as to allow the wire to be properly applied. When the wire has been made to encircle the base of the mass in the desired place, generally just above the internal os, it is drawn up as tightly as possible by means of a special pair of forceps, and twisted twice round the knob of the screw of the serre-nœud, and then twice round the stem; the wire is then slowly and carefully screwed up. Haste or undue force may break the wire or cut the uterus, and cause serious hæmorrhage. The wire loop must, of course, be firm, but it is better not to screw it up too forcibly at first, as it can be tightened little by little afterwards as the tissues shrink and when the uterus and tumour have been cut away. When the wire has been screwed up, a long strong pin, with a little looped handle at one end to hold it by, should be pushed through the whole mass just on the distal side of the wire, and its point protected by a little cap which screws on over it. Sponges are then packed round the base of the tumour, and it is rapidly cut away; it is well to leave a large stump at first, as it can be trimmed down after the wire is finally screwed up and the other steps of the operation completed. If the ovaries and tubes are included in the wire (not tied off separately), care should be taken in putting the pin through to make it thoroughly transfix the broad ligament on both sides as well as the uterine stump, and it is advisable also to run a needle, threaded with a strong silk, round the cut peritoneal edge of the broad ligament on each side and into the fibrous tissue of the stump, and thus tie the cut broad ligaments, bag-mouth fashion, tightly to the edges of the stump. Adhesions having been all secured, the peritoneum should now be sponged out, especial care being taken to cleanse the pouch in front, which is practically shut off from the general cavity, when the operation is completed.

The stump is then held up in the lower angle of the abdominal incision and a strong silk suture is passed through the peritoneum and parietes just above it, and at once tied so as to hold it in position. This suture should not be too tight, or it may cause suppuration by tension, but it should be tight enough to keep the peritoneum and other tissues closely applied all round the stump. It is better not to place any suture below the stump. The remaining sutures are now introduced and the wound closed. Drainage by the glass tube is to be especially avoided in this operation, because the mouth of the tube comes out close to the uterine stump, in the centre of which is the opened uterine cavity—a certain source of sepsis; and if the tube is once put in, and requires to be kept in beyond the first two or three days, putrefaction will be almost certain to invade it from the stump. When the abdominal cavity is closed, the stump should be pared down as closely as it safely can be; it is

better to cut out its central solid part, and leave its peritoneal edges rather longer. When it has been sufficiently pared, it is carefully packed round with small pieces of dry carbolic gauze, which should also be placed under the pin and serre-nœud to prevent them from cutting into the skin, as there is frequently considerable pressure upon them in the course of the first week after operation. The raw surface of the stump should be carefully treated with solid perchloride of iron: this dries it, and prevents it from decomposing. Of course, care must be taken not to put on so much iron that it can, before the peritoneum has sealed, trickle beside the stump into that cavity; but the surgeon who allows this must be a very clumsy manipulator.

In ordinary cases, especially when adhesions are absent and the appendages can be included in the wire of the serre-nœud, the operation of supra-vaginal hysterectomy is an extremely simple one, and far easier than a difficult ovariotomy, or than any operation for the removal of the uterine appendages; but in cases with many adhesions, or in which there is a broad base requiring enucleation from the broad ligament before the wire can be applied, it may be an exceedingly difficult one. The hæmorrhage from adhesions and during enucleation is often very profuse, and may try the nerve of the bravest surgeon. In dressing the wound after operation, the upper part of the incision should be dressed with a separate dressing, and then the lower straps and the dressing over and round the stump can be changed as often as is necessary, while the main part of the incision can be left undisturbed, as in ovariotomy, till it is time to remove the sutures. If the stump be carefully treated with perchloride of iron at the time of operation, the first dressing may be left on two days, then changed under the spray, the screw tightened, the stump clipped and redressed with iron, and this may be repeated every second day, until very little of the stump remains to separate or cut off when the serre-nœud and pin are removed. Sometimes, the wire cuts through in a couple of weeks, and the serre-nœud, pin, and stump are found loose under the dressing, but more often it is necessary to cut through the wire and remove it about that time, and clip away the dead stump. Care is required, in doing this, to avoid cutting into living tissue, or very severe hæmorrhage or serious septic absorption may result. Even when cutting in the slough, the mucous membrane lining the remains of the uterine cavity will often be still living, and bleed so as to require the application of a little fresh iron.

After the removal of the serre-nœud, &c., or its natural separation, the stump sinks deeply and forms a cone-shaped depression which heals slowly by granulation. If the drag on the stump has been great, it may tear the tissues which have adhered round it as it sinks, and some hæmorrhage may occur, or still more dangerous septic absorption; and whenever this seems probable, it is well to touch the granulation-tissue all round with the perchloride of iron: this at once checks any oozing and seals the small vessels. Various other methods of treating the stump have been tried, but none is so sound, both in theory and practice, as the use of the perchloride when it is properly applied.

Wire clamps and serre-nœuds of various kinds have also been invented, and the old ovariotomy clamp has still its advocates; but the Kœberle serre-nœud is infinitely easier of application, simpler, cleaner, and more efficient than any of them.

The method above described is called the extra-peritoneal, in contradistinction to the various methods of ligature of the stump with suture of flaps, and dropping it into the peritoneum. The fatal objection to all the intra-peritoneal methods is, that in the opened uterine cavity of the stump there is a putrefactive centre, and, however it is treated, it is impossible to be quite sure that it is rendered aseptic or thoroughly shut off from contaminating the newly-cut surfaces. The most dangerous of these methods is undoubtedly the imitation of the practice in ovariotomy—i.e. transfixion, ligature, and simple dropping of the stump. In this method the putrefactive centre is left in the middle of half-strangled uterine tissue, actually open in the peritoneum; and the terrible mortality of the procedure makes it quite unjustifiable.

Schrœder has proposed and practised, with considerable success, the following method: the appendages are ligatured off, and a strong elastic ligature is temporarily placed round the uterus instead of the wire; the tumour is cut away, and a V-shaped piece is cut out of the centre of the stump; the cavity is cleaned or cauterised with strong carbolic acid solution (1 to 10); the mucous edges of the cut cavity are sutured together at the bottom of the V, and the sutures cut short; successive rows of sutures are then applied, cut short, and covered in by the succeeding rows until the peritoneal edges are reached and sutured. The elastic ligature is then

removed and the stump dropped in. The objection to this method is, of course, less than to the simple ligature mentioned above, but the cleansing of the uterine cavity must be imperfect and uncertain, and the sutures in the cut edges of the uterine cavity are very liable to absorb putrid material, and become so many centres of septic infection. The enclosing of successive rows of short sutures in dense tissues, without provision for escape of effused products, is also objectionable. In cases in which it is impossible to bring the stump outside with the wire and pin, this is doubtless the next best method.

In some cases, it may be necessary or advisable to employ both methods, bringing the central stump out with the serre-nœud, and closing large cavities in the broad ligament, left by enucleation of the base of the tumour, with sutures. It is, however, still an open question whether it is not better to secure all bleeding points and allow the edges of the cavities simply to fall together, so as to avoid collections of fluid in closed spaces, the serum running into and being rapidly absorbed by the peritoneum if it is allowed free access to that cavity.

Another extra-peritoneal method, which has succeeded well in Germany, is the replacing of the serre-nœud by the elastic ligature, the stump still being pinned outside and treated with chloride of zinc.

If it be absolutely necessary to use the glass drainage-tube in any of these operations, its mouth should be shut off as much as possible from the stump and wound by being made to project through a pure rubber sheet, which grasps its collar tightly and is filled with carbolised sponges, to take up the discharge as it overflows from the tube.

Whether a cure be brought about by removal of the uterine appendages, or by some method of hysterectomy, it is clear, from recent results, that a new and successful era has dawned in the surgical treatment of uterine tumours.

J. Knowsley Thornton.

UTERINE TUMOURS.—Fibro-myomata, fibro-cystomata, polypi, sarcomata, and the various forms of carcinoma, are all of great importance, as their presence necessitates some of the most formidable operations which the surgeon is called upon to perform. They vary so greatly in their causes, symptoms, diagnosis, and treatment, that general remarks upon them are of little value, and each is therefore discussed separately.

Fibro-Myomata, as their name indicates, are composed of fibrous tissue and unstriped muscle-cells, the relative proportions of these tissues varying much in different growths.

Cause.—There is but little, if any, definite knowledge of the causes which excite the growth of these tumours; probably, they owe their origin to prolonged congestion and inflammation of the uterine walls, and anything which produces these pathological states may start their formation. Irregularities of menstruation, displacements of the uterus, and mechanical injuries, are exciting causes. Single and married women are both liable to them, but married women are their more frequent hosts. Married women, who are childless, more often have large tumours than those who have borne children; but this may be in part, at any rate, due to the fact that the involution of the uterus, which follows childbirth, frequently causes the absorption and disappearance of these growths. Small fibro-myomata, which would have grown large in single or sterile women thus disappear, probably in many cases without their presence ever having been detected. Their presence may also cause sterility.

Pathology.—The appearance on section, and the density of a fibro-myoma, vary according to the relative proportion of fibrous and muscular tissue which it contains: when the former predominates it is glistening, white, and hard, cutting like cartilage; when there is a preponderance of the muscular element it is soft and red-looking (fleshy). The substance of the growth is but sparingly supplied with blood-vessels, but large vessels ramify over its capsule, from which it appears to derive much of its nutrition. There is usually one point at which its tissues are directly continuous with those of the uterine wall, and here such blood-vessels as it possesses enter; hence, the broader this base the greater the vascularity of the growth, and, as a rule, also, the more pronounced its muscular element. Generally, there is a distinct capsule of areolar tissue, but sometimes the growth seems merely to occupy a hollow space among the proper tissues of the uterus. Lymphatic spaces are sometimes found between the bundles of fibrous and muscular tissue, and nerves have been traced into the substance of the tumours.

There are three chief varieties named according to their relation to the proper uterine tissues—subperitoneal, interstitial or mural, and submucous. The first and last may be either pediculate or sessile. The subperitoneal are the slowest in growth and usually the least dangerous, as they do not,

as a rule, enlarge the uterine cavity, and do not give rise to hæmorrhage; they are apt, however, to cause ascites from mechanical irritation of the peritoneum, and, from the same cause, form adhesions to surrounding organs. The interstitial and submucous both enlarge and deform the uterine cavity; the former are often a cause of much pain, and the latter of serious hæmorrhage. All varieties are liable to degenerative changes —cystic, calcareous, and suppurative—and the submucous are apt to cause necrosis of the mucous membrane, and then slough themselves. The interstitial variety often cause very considerable hypertrophy of the whole uterus, and thus produce hæmorrhage of a different kind from that due to the submucous. All much more commonly affect the body of the uterus than the cervix, and the almost pure myoma is commonly situated in the fundus.

Symptoms and Diagnosis.—The chief symptoms which indicate their presence are disordered menstruation, especially menorrhagia and metrorrhagia, pelvic pain, and a sense of fulness and bearing down, vesical and rectal troubles, nerve pains in the lower extremities, and œdema of feet, legs, or vulva. Some one or all of these symptoms may be present while the growths are comparatively small, and may disappear with the later symptom of abdominal enlargement, just as like symptoms disappear when the pregnant uterus rises out of the pelvis. In a large number of cases they produce no symptoms at all, and sometimes they attain an enormous growth without the patient knowing that there is anything wrong.

The diagnosis of their presence must be made chiefly by their physical examination by the vagina, by the rectum, and externally, and by a combination of these methods; the symptoms to which they give rise being also useful as corroborative of the more definite physical signs. The latter are their consistence, their continuity with the uterus, and their relations to neighbouring organs which are found to be healthy. The differential diagnosis has already been given, to some extent, under Ovarian Tumours, as they have to be differentiated from the same morbid conditions there described. In the majority of cases, anyone with fair experience and careful examination will find no great difficulty; but, when they are small and confined to the pelvic cavity, it is sometimes quite impossible to be absolutely certain. The uterine sound, denoting the length of the cavity, is useful for the interstitial and submucous varieties, but is of little use for the subperitoneal, as the cavity is with them often normal, and moving them in the abdomen does not affect the sound *in utero* more than the same moving of an ovarian tumour with a short pedicle. The sound should always be used with extreme care or it may give rise to very dangerous hæmorrhage, or, by perforating a thinned mucous membrane, cause sloughing of the growth and septicæmia.

Treatment.—If it be thought advisable to remove a subperitoneal fibro-myoma which has a pedicle, the operation is exactly the same as Ovariotomy. The extraction of the large solid growth will probably require a longer incision, and may be facilitated by screwing a strong corkscrew into the growth, and using this as a handle to lift it out of the peritoneum. The pedicle should be firmly tied by a No. 4 silk ligature, and the ends of the ligature should then be threaded into a strong straight needle, and passed through the pedicle on the distal side of the first tie, and then again firmly tied round each half of the pedicle. By this method any oozing from the transfixion puncture is avoided.

If the pedicle be very thick, it may be prepared for the silk ligature by having an elastic ligature first applied, or the wire of a serre-nœud firmly screwed up, and then the silk is tied in the groove thus formed, the elastic ligature or wire having been first removed.

If the pedicle be too thick to admit of this treatment, a temporary elastic ligature should be applied round the body of the uterus, the tumour cut away, and two flaps formed out of its pedicle or its base in the uterine wall. These flaps should then be brought together by a succession of rows of fine silk sutures, the first row being applied at the bottom of the angle between them; the flaps are cut short and covered in by a second row applied in the middle of the flaps, and these again are covered in by a third row applied to the peritoneal edges (Schrœder's method). In cutting the flaps, care should be taken not to cut so deeply as to open the uterine cavity.

Submucous fibro-myomata which bulge much into the uterine cavity, especially if the mucous membrane over them has necrosed, may be removed by enucleation. The cervix is dilated by Hegar's dilators, the capsule of the tumour is incised, and the growth is enucleated by the operator's fingers, which may be aided in some cases by Thomas's spoon-saw. If the base be very broad, it may be necessary to divide it

with the écraseur. Bleeding points may be touched with perchloride of iron, or compressed with long pressure-forceps, and the cavity stuffed with plugs of iron cotton. A very efficient method of checking oozing, and at the same time securing asepticity, is to plug the cavity with a sponge squeezed out of tincture of iodine. If this be used, it must be long enough to project through the cervix, or it may be drawn within the cavity, when the cervical canal will close and its extraction will be a matter of much difficulty. If it be left projecting well into the vagina, the uterus will expel it in the course of twenty-four hours, or it can be easily drawn out. In all cases, full doses of ergot should be given for the first few days after enucleation, and the vagina must be frequently syringed out with some antiseptic solution.

If the submucous tumour has a very broad base, and is deeply bedded in the uterine wall, it is better to treat it in the same way as the intramural variety—i.e. by the removal of the uterine appendages.

If an intramural fibro-myoma, a submucous fibro-myoma, or a general thickening of the uterine wall be thought to necessitate operation, the removal of the uterine appendages is the operation to be recommended. *See* Uterine Appendages, Removal of the.

In advising this operation, however, it is necessary to explain to the patient that, though it will probably cure, the process is a gradual one, and, also, that after the abdomen is opened the relation of the ovaries and tubes to the tumour, or the adhesions they have formed, may be such as to render the operation impossible, or to make it more difficult and dangerous than the complete supra-vaginal ablation of the organ (supra-vaginal hysterectomy). In ordinary cases, the operation of removal of the appendages is a much less dangerous one than a complete supra-vaginal hysterectomy, but it should always be left to the discretion of the surgeon which operation he will employ, when he has opened the abdominal cavity and thoroughly examined the tumour.

Fibro-Cystomata.—These are rare, and usually arise from softening of a fibro-myoma, the fluid being contained in spaces between the bundles of fibrous or muscular tissue, and large cavities being formed by the absorption of the intervening trabeculæ. In another form the fluid gathers in lymph spaces, and the cavities are lined with endothelium.

The symptoms are identical with those which arise from the presence of the solid growths, except that the fibro-cysts expand very rapidly. If an old fibro-myoma begin to enlarge quickly, it may generally be inferred that it is becoming cystic.

The diagnosis, except in this last form, is very difficult, as fibro-cystoma closely simulates ovarian tumour. The uterine sound may in some cases aid in the formation of a correct opinion. It is not a matter of much moment, as their rapid growth renders it necessary to remove them whenever possible. The operation for their removal corresponds with that for the removal of fibro-myomata, except that they may be reduced by tapping before extraction. Sometimes they are pediculate, and sometimes they may be enucleated, but more often it is necessary to perform complete supravaginal hysterectomy.

Polypi. — Submucous fibro-myomata, which are in process of spontaneous enucleation, may become polypoid (fibrous polypus). They are often very large, distending the uterine cavity or the vagina, or even protruding from the vulva. They are rounded or pyriform in shape, and usually have a smooth covering derived from the mucous membrane of the uterus. The base may be broad and thick, or so long and narrow that the growth is entirely extruded, only its stalk remaining in the cavity of the uterus. As they are not very vascular, the base or stalk rarely contains any large vessels.

Mucous polypi are rarely of large size, and are more often developed from the endometrium than from the cervical mucous membrane. Their structure corresponds with that of the mucous membrane from which they spring, and they are extremely vascular. Pediculate Nabothian follicles and placental polypi are also occasionally met with, and their names sufficiently indicate their origin.

The submucous polypi may degenerate into sarcoma or be sarcomatous from the first, and are then apt to recur after removal. The mucous polypi are also liable to both sarcomatous and carcinomatous degeneration.

Symptoms.—Sometimes polypi give rise to no symptoms, or simply to some sense of irritation and discomfort, or they cause leucorrhœa or dysmenorrhœa, but their most serious and common symptom is uterine hæmorrhage; this may merely show itself as menorrhagia, or metrorrhagia, or there may be a constant bloody discharge.

Sterility may be caused by their presence, or, if pregnancy occur, they may greatly impede delivery.

Diagnosis.—When they are still contained in the cavity of the uterus, it may be impossible to differentiate them from other conditions causing like symptoms, and the cervix must be dilated for their discovery. When they protrude through the external os, they are readily recognised either by touch or sight. An inverted uterus may be mistaken for a fibrous polypus, but a careful examination of the relations of the mass at its neck, and the passage of the sound into the uterine cavity, should render the differential diagnosis easy.

Treatment.—When dilatation is necessary, the polypus should be removed at the same sitting, and it may be either twisted off, cut off with scissors, or with the écraseur, according to the size and vascularity of its neck. The mucous polypi may usually be twisted off, but if large should be tied, as they are very vascular. After removal of the growth, the uterine cavity and cervical canal should be cleansed with tincture of iodine, and it may be necessary to adopt some kind of plugging, as described after the enucleation of a submucous fibro-myoma. If the polypus be so large as to block the vagina and distend the vulva, it may be necessary to cut it up with the chain écraseur, and remove it bit by bit in order to obtain access to its pedicle.

There are various methods of dilating the cervical canal. It may be dilated slowly by sponge, or tangle, or tupelo tents, or it may be dilated at one sitting by graduated bougies or dilators, the patient being in the lithotomy position and anæsthetised. The latter is far the safest and most satisfactory method, and is much pleasanter for the patient. Hegar's dilators are the best, and full dilatation may generally be obtained in about an hour. The uterine cavity should always be sponged out after their use, first with dry cotton on a Playfair's probe, and then with cotton that has been dipped into tincture of iodine. The vagina should be frequently syringed with some antiseptic solution till all discharge ceases.

Some operators prefer the Sims position, but the lithotomy position is much more convenient for the operator, and it dispenses with the need for the use of a speculum.

Sarcoma.—Sarcoma of the uterus is met with in two forms—the diffuse and the circumscribed, and differs from carcinoma in that it more often affects the body than the cervix.

The diffuse form arises from the subepithelial connective tissue, and grows in rounded nodules which project into the cavity, causing softening and disintegration of the mucous membrane, which is liable to carcinomatous degeneration; and this causes a complication which is very likely to mask the original disease. The circumscribed form occurs more often in the uterine wall, and differs from fibro-myoma, as it has no capsule.

By some these uterine sarcomata are believed only to occur as degenerations of pre-existing fibro-myomata, but this is very unlikely, as there is no reason why sarcoma should not grow from the cellular tissue of the uterus as well as from that in other situations. The round-cell sarcoma is the most common form, but other varieties are occasionally met with. The only cure for sarcoma is, as for carcinoma, the complete extirpation of the uterus.

Myxoma is also found, and may be a degeneration of the connective-tissue elements of a fibro-myoma, or be mixed with the ordinary sarcoma, as in other situations. The myxoma is of special interest to the surgeon, because this form of tumour is not amenable to treatment by the removal of the appendages, but may be dealt with by supravaginal hysterectomy if it is entirely confined to the body of the uterus, and the same treatment may cure the circumscribed sarcoma if the operation be performed early enough.

Carcinoma.—There are three varieties of this disease which are generally recognised as affecting the uterus—encephaloid, scirrhus, and epithelioma. The two first are really the same disease, but the encephaloid is softer and more rapid in its progress from the predominance of the cellular elements; while the scirrhus form is harder and slower in its progress, the fibrous element being more marked than the cellular. Epithelioma also occurs in two forms, one flat and the other papillary; the former occurs chiefly in the cervical canal and in the interior of the uterus, and the latter more often at the os, projecting into the vagina as the well-known cauliflower excrescence. All varieties of the disease attack the cervix much more often than the body of the uterus.

Causes. — Heredity is a predisposing cause in from seven to ten per cent. of all cases. Age is also a predisposing cause, the vast majority of cases occurring between thirty-five and seventy-five, the mean between these extremes being the most common period for its occurrence. Anything which greatly depresses the vital powers also appears to predispose to the disease.

Married women who have borne many children or who have had many miscar-

riages are especially liable to uterine cancer, particularly if the births or miscarriages have followed one another very quickly. It is commoner among the poor than among the rich. Erosions and lacerations of the cervix and chronic uterine catarrh also favour the production of this disease.

Pathology.—There is wide difference of opinion as to the pathology of uterine cancer. Virchow and his followers, among whom Ruge and Veit must be specially mentioned, believe that it has its origin in the connective tissue; while Thiersch, Waldeyer, and others believe that it grows from the epithelium, and they are again divided in opinion as to the exact layer of epithelium from which it springs.

Symptoms.—These, of course, vary according to the stage, situation, and variety of the disease. In the early stages, hæmorrhage, and pain in the back, pelvis, and down the thighs are the prominent symptoms. Later, when ulceration has commenced, watery discharge, wasting and general debility, disturbance of the digestive organs, yellowness of the skin, and special pains according to the organs which are implicated, notably of the bladder and rectum.

In the still more advanced cases, dribbling of urine, escape of fæces from the vagina, hydronephrosis from obstruction to the ureters, or jaundice from secondary deposits in the liver, herald the fatal termination. Peritonitis, sudden and severe hæmorrhage, or thrombosis are among the rarer accompaniments of advanced disease.

Exhaustion, uræmia, septicæmia, peritonitis, hæmorrhage, and thrombosis are the common causes of death, the two first accounting for the larger share of the mortality.

Diagnosis.—In the early stages the diagnosis is often extremely difficult, especially in the rare cases of cancer of the body.

The early stages of cervical cancer will have to be diagnosed from mere inflammatory induration with erosion, from syphilitic ulceration, from simple hypertrophy of the cervix, from lupus, from sloughing polypi or fibro-myomata, from retained portions of placenta or membranes, and from sarcoma. If the disease be in the body, it may be necessary to dilate the cervix and scrape out a small portion for microscopical examination, and, if in a more accessible situation, microscopic investigation will alone give a certain diagnosis.

Careful examination of the pelvic tissues surrounding the uterus, made both by the vagina and rectum, is also important.

Treatment.—This is either palliative or radical; the former belongs rather to the physician, but may be briefly referred to.

The local application of iron or of other styptics and astringents will be useful for checking hæmorrhage, also cold applied to the vulva and cold water injections, ergot and gallic acid internally; plugging the vagina may be necessary, or the use of strong caustics or of the actual cautery. Offensive discharge must be treated by frequent antiseptic injections. Pain must be relieved by the hypodermic injection of morphia, by atropine and morphia combined, by chloral, and by sedative pessaries. Iodoform is reputed to be useful both for relieving pain and as an antiseptic. Chloride of zinc is valuable both as a caustic and as a disinfectant.

J. Knowsley Thornton.

UTERUS, Extirpation of the.—*Abdominal Operation* (Freund's).—The usual incision having been made through the parietes and the peritoneum opened, the intestines are drawn out of the pelvis, the broad ligaments are transfixed on each side by three ligatures which are made to interlock when tied; the first loop passes through the ovarian ligament and edge of the peritoneal covering of the Fallopian tube and secures the ovarian vessels, the second loop passes through the round ligament and secures the *pampiniform plexus*. When the first two loops have been tied on each side, the ovaries and tubes are cut away, and the uterus is firmly drawn up out of the pelvis by a ligature passed through the fundus, or by a special forceps, and a transverse incision is made through the peritoneum between the uterus and bladder; the latter is then peeled back, and the incision carried through into the vagina. The uterus is then held forwards, and the peritoneum divided transversely behind to the same extent as in front, and the vagina opened into through the pouch of Douglas. The uterus is now merely held by small portions of tissue on each side, which contain the uterine arteries, and the third loop of the broad ligament ligatures is passed through on each side into the vagina, or from the vagina by a special grooved needle, and tied round the tissues containing the uterine arteries; these small bridges of tissue on each side are then cut through and the uterus removed. If the vagina is large enough to allow the separated uterus to be drawn through it, it is better to remove it by that outlet than through the abdominal incision, as there is less chance of fouling the wounded tissues

and peritoneum with the cancerous discharge.

The various steps of the operation will be facilitated by inserting an india-rubber bag, with a tube to it, into the rectum, blowing it up and tying the tube; this raises the uterus and appendages out of the pelvis, and may enable the operator to dispense with the use of the transfixing ligature or forceps to draw up the uterus. Both these are to be avoided if possible, as the punctures they make may allow putrid fluid to ooze through on to the peritoneal surfaces, whilst manipulating the organ during the various steps of the operation.

When the uterus has been removed, any bleeding points, not already secured by the transfixing ligatures, are tied with fine carbolised silk ligatures with their ends cut short; a large T-shaped rubber drainage-tube is then placed in the deep parts of the wound with its central limb protruding through the vagina, and the edges of the peritoneal wounds are brought together by points of interrupted suture, so as to shut out the tube and deeper raw surfaces from the peritoneum; the abdominal incision is then closed in the usual way. In his later operations Freund has abandoned the peritoneal suture, and leaves the ligatures which transfix the broad ligaments uncut, and hanging out in the vagina. It is, of course, advisable to thoroughly cleanse the vagina, before the operation, with a strong antiseptic irrigation, and the cervical canal may be packed with cotton or sponge soaked in a strong antiseptic such as tincture of iodine. These are necessary precautions, but they cannot be depended upon for preventing the access of septic material to the wounded surfaces, sponges, or peritoneum during the progress of the operation, and the use of the spray and full Listerian precautions are therefore not of the same importance as in other abdominal sections, in which fresh and pure surfaces only are dealt with.

Various modifications have been suggested in the method of applying the ligatures, but they are unimportant, and space will not allow their discussion. In some cases the vessels may be ligatured as they are divided, and if there is a flaccid abdomen and roomy pelvis, this modification may be found possible, and has the great advantage of avoiding the ligature of masses of tissue along with the vessels.

Vaginal Operation (Schrœder's).—The vagina and uterus having been thoroughly cleansed with strong antiseptic solution, and the patient placed in the lithotomy position in a good light, the operator seats himself in front of the perineum with his back to the window. Seizing the cervix with a strong vulsellum, which he hands to an assistant to hold, he cuts through the vaginal mucous membrane all round the cervix, giving the disease as wide a berth as possible. The pouch of Douglas is then opened, and two fingers, passed in and over the fundus uteri to the front, enable the opening into the vagina to be safely made between the uterus and bladder; the fundus is then retroflected and forced into the vagina through the opening in the pouch of Douglas. The broad ligaments are now transfixed and ligatured on each side, and the uterus is drawn down, separated from them, and removed. Any bleeding points are separately tied and a T-shaped drainage-tube introduced; the broad ligament pedicles are secured in the angles of the wound by a point or two of suture on each side, or the wound may be left altogether open, the drainage-tube being merely packed round with antiseptic cotton or gauze. One great objection to this operation is that the ovaries and tubes are usually left behind, because if they are removed there is not room to securely ligature the broad ligaments, and secondary hæmorrhage may ensue. The leaving of the ovaries is not a matter of much consequence, but the tubes are structures in direct continuity with the uterus and its lining membrane, and leaving them is a fundamental breach of the law which governs all operations for the removal of malignant disease. Structures in continuity with the diseased parts, or, in other words, the entire organ diseased, should always be removed, or operative procedures are not justifiable. The great danger, in both the abdominal and vaginal operations, is the risk of including the ureters in the ligatures which secure the uterine arteries. That this is a real danger the autopsies of fatal cases abundantly prove. Septicæmia is another great danger, and in dealing with necrosed cancerous tissues it is often impossible to avoid infection of the wounded surfaces; hence, free drainage is an essential in these operations, and antiseptic irrigations should also be employed.

The vaginal operation is decidedly the simplest and least fatal, but a serious objection to it has been pointed out above, and, at present, the ultimate cures are so few that the results of the operation cannot be pronounced encouraging. Time alone can decide whether complete extirpation of the uterus for cancer is destined to establish for itself a permanent place in surgery, or

is to sink into oblivion again, as it has already done in the past, after a very decided attempt to establish it, though not on such a careful and scientific basis as in the present revival of the operation.

Partial Operations.—The above operations are, of course, the only procedures possible when cancer invades the body of the uterus, but in the commoner forms of epithelioma which attack the os and cervix, partial operations will often give much relief and decidedly prolong life, while at the same time making it, while it lasts, tolerable both to the patient and to her friends.

The cautery, caustics, the écraseur, the scissors, and the knife each have their advocates.

The method introduced by the late Marion Sims is on the whole the best. The diseased parts are freely cut away with the scissors, then the raw surface is curetted till healthy tissue is reached, and the cavity left is packed with iron cotton (subsulphate of iron one part to two of water) and the vagina plugged with antiseptic wool. Iodoform gauze is also an excellent material. In forty-eight hours the plugs and iron are removed, and the cavity carefully packed with cotton wrung, almost dry, out of a solution of equal parts of chloride of zinc and water. The vagina and surrounding tissues are protected by being smeared with equal parts of vaseline and bicarbonate of soda, and the vagina packed with plugs of wool wet with a solution of the latter drug. After the removal of these plugs, which may be safely left in position for four or five days, as the chloride of zinc is a powerful antiseptic, the vagina is frequently syringed with an antiseptic solution. In due time a thick white slough of the wall of the cavity separates, either gradually or in a large cast; the raw surface is then carefully examined, and, if any suspicious points are seen, they are again packed with the chloride of zinc cotton. Then, from time to time during cicatrisation, the surfaces are carefully examined, and if necessary a further application is made. In ordinary cases but little risk attends this procedure, and very satisfactory results are often obtained. Care must be taken, however, not to leave the iron cotton too long, or septicæmia may result, as mixtures of blood and iron seem to have a special tendency to rapid putrefaction when wet. A good substitute for the iron solution is the ordinary 1–20 carbolic lotion, saturated with pulverised alum. Hæmorrhage is rarely troublesome, but it may be necessary to use forceps or the actual cautery to some of the bleeding points, before packing in the iron cotton. If the disease be very extensive, and the cutting and scraping carried far into the cavity of the uterus, care must be taken in packing with the chloride of zinc, or the thin shell of uterine tissue may be perforated and fatal peritonitis result. In cases in which much of the uterus has to be cut or scraped away and the operation is prolonged, very alarming collapse sometimes comes on.

Schrœder has introduced two other partial operations, which are worthy of notice, and are applicable according to the extent to which the disease has penetrated the cervical tissues.

Amputation of the vaginal portion is performed by dividing the cervix deeply with scissors on each side, so as to form an anterior and posterior lip, then removing a wedge-shaped portion from each of these artificial lips, and uniting the flaps with sutures. The lateral incisions are also sutured. Supra-vaginal amputation of the cervix is performed by drawing the cervix down with a vulsellum, dividing the vaginal mucous membrane round the base of the anterior lip into the cellular tissue, and peeling back the bladder, which carries with it the ureters; then carrying the cervix forward, and incising the mucous membrane of the posterior fornix till the ends of the incision meet those made in the anterior fornix; then clearing the sides of the cervix. This is more difficult, as the cellular tissue is dense, and larger vessels are apt to be divided and should be ligatured. The cervix is cut out by the knife in a wedge shape, and the anterior cervical wall is sutured to the anterior vaginal wall, and the posterior cervical wall to the posterior vaginal wall. The lateral wounds are closed with sutures deeply placed, so as to control hæmorrhage.

In some cases, the pouch of Douglas is opened and a portion of it may have to be excised with the cervix. Schrœder had thirty-three immediate recoveries out of thirty-seven operations, so that the operation is not so dangerous as it would appear likely to be. J. Knowsley Thornton.

UVULA, Diseases of the.—The uvula in its normal state consists of a thin mucous membrane superficially, a subjacent layer of racemose glands, and the fasciculi of the 'azygos uvulæ' muscles in the centre. Its physiological variations with regard to form and size are considerable, and it may be congenitally deficient, or may present a median fissure in consequence of a failure

in the union of its component halves during the process of development.

As a dependency of the velum palati it is liable to all the affections of that structure (*see* PALATE), and morbid conditions, extending from adjacent parts, may induce a special train of symptoms referable to the uvular lesion, or may become almost entirely confined to the appendage. It may also become involved in more general or remote diseases, sharing in the manifestations of anæmia, hyperæmia, and anasarca; deflected to one or other side in facial palsy, or hanging powerless in bulbar and some other paralytic complaints.

The diseases of the uvula which require a separate consideration are atonic relaxation, chronic inflammation ('hypertrophy'), and certain neoplasms.

Atonic relaxation of the uvula depends upon partial or complete loss of power in the azygos uvulæ, a condition favoured by muscular debility, and usually excited by excessive use of the voice, as in singers, public speakers, &c.

The affection, when unassociated with inflammation, often escapes recognition, since the organ may present no alteration of appearance beyond an increase in length. It will, however, be found that, during contraction of the muscles of the velum in phonation, it hangs almost or quite motionless; while the patient observes that his voice has lost both strength and quality. In some cases, nausea and paroxysms of coughing may be induced by contact of the flaccid appendage with the pharynx or glottis.

In the treatment of this disorder, repose of the affected parts, the local use of astringents, and the internal administration of tonics may be sufficient to effect a cure; but, should these measures fail, the superfluous length of the organ must be cut off. This operation may be effected (after the parts have been rendered anæsthetic by cocaine, if necessary), with a pair of ordinary blunt-pointed scissors, while the extremity of the uvula is held with forceps; or use may be made of specially constructed 'uvula scissors,' which seize the part to be removed at the moment of cutting. It entails no bad after-results, and, although some trouble has arisen from hæmorrhage in exceptional instances, the loss of blood is usually limited to a few drops. Should it be necessary, the bleeding may be checked by the application of a piece of lint steeped in a strong solution of perchloride of iron.

Chronic inflammation or '*hypertrophy*' of the uvula is an occasional result of repeated catarrhal affections of the parts. The uvula undergoes a persistent enlargement, assuming in some cases the size of a thumb, and reaching down to the orifice of the glottis. The mucous surface is usually red and dry, and the muscular movements are impaired or lost. Histological examination has shown that the morbid changes are principally located in the submucous tissue, which becomes enormously thickened by inflammatory proliferation, and the papillary layer of the mucous membrane is slightly increased in depth. The muscular and glandular elements are little altered.

The effects are very variable. In some cases, the enlargement may attain considerable proportions without entailing any inconvenience, but in others a distressing train of symptoms may follow: a sense of discomfort in the throat, as from the presence of a foreign body; severe attacks of coughing, especially on rising in the morning and lying down at night, and on exposure to cold or after exertion of the vocal organs; and the voice may become harsh or hoarse and more or less enfeebled. The cough is usually of a peculiar character—remarkably metallic and barking, paroxysmal, difficult to check when the fit is established, and liable to terminate in sickness, but there is little or no expectoration unless the condition be complicated with laryngeal or bronchial catarrh. Occasionally, the contact of the swollen appendage with the back of the pharynx may induce frequent hawking and retching, or even vomiting; and, where the extremity of the uvula extends as far as the glottis, violent suffocative paroxysms may be superadded.

In this state the patient may continue for months or even years, alarming himself and his friends by an incessant cough, the noisy character of which is popularly supposed to be of dire portent; incapable of exercising his vocal functions without distress; and consuming numberless bottles of useless expectorants; until the real nature of the complaint is detected and proper measures employed, when the symptoms are ended by an apparently magical cure.

The treatment is that of simple relaxation—rest to the voice, local astringents, tonics, and, should they fail, amputation of the appendage. The morbid dilatation of the vessels may give rise to some little bleeding when the redundancy is cut off, but this will yield readily under the application of styptics.

Neoplasms. — The only tumours that have been found localised to the uvula are small papillomata and polypi, both of which may be removed by the scissors.

WILLIAM ANDERSON.

V

VACCINATION is the inoculation of the virus of cowpox. Cowpox is a vesicular disease of the cow, the vesicles appearing on the udder and teats of milch cows, and more frequently on young animals than on those which are older. Observers describe the incubation-period of the so-called natural disease to be usually of three or four days' duration, while that which is known to be transmitted by inoculation by milkers is believed to be two or three days longer. Apart from this difference, the subsequent local manifestations are identical: a papule forms which develops, and, at the end of three or four days more, becomes vesicular and umbilicated. During each subsequent day the vesicle increases in size, and, on the tenth or eleventh day or earlier, an areola forms which gradually extends, while the contents of the vesicle become cloudy and purulent and the vesicle loses its umbilication. From this time a crust forms over the surface, the vesicle becoming dried up and disappearing, the crust remaining for five or six days before it is finally shed.

The apparent difference in the incubation-period, between the natural and inoculated cowpox, is probably due to the fact that the moment at which inoculation takes place could not be ascertained, and if this explanation be accepted, the probability becomes greater that the disease is communicated by inoculation alone; later, under the heading *Animal Vaccination*, it will be seen that the incubation-period of inoculated cowpox is much shorter than the period stated. There is said also to be frequently variation in the length of time occupied by the various changes, and that, on the same animal, the eruption is often found to consist of papules and vesicles in different stages of development; this is probably the result of inoculation from some of the earlier vesicles, or of fresh inoculation from the original source of infection. Space does not permit a description of other vesicular diseases of the cow, but it will suffice to say that these affections are often mistaken for cowpox, and have thus led to some confusion.

There is much difference of opinion as to the origin of cowpox. Jenner, in the first instance, believed that it resulted from the inoculation of a vesicular disease of the horse known as 'grease.' Subsequently, it was found that this affection was altogether distinct from cowpox, but that the horse was also liable to suffer from horsepox just as the cow was liable to suffer from cowpox. In the horse, however, the vesicles occur most frequently on the hocks, and are not limited to animals of the female sex. It has also been observed that cowpox has appeared among herds of cows who had not been exposed, either directly or through their milkers, to infection from horses. Finally, experiment has shown that the cow can be inoculated with horsepox and the horse with cowpox, rendering both these animals insusceptible to any effect from further inoculation by horsepox, cowpox, or smallpox. Horsepox and cowpox may, therefore, be regarded as identical, and the only point remaining for discussion is the relation of this affection to human variola.

Attempts to inoculate the cow with variolous matter have produced very different results in the hands of different experimenters. Briefly, it may be stated that in the hands of many experimenters the inoculation has altogether failed; in the hands of others a papule has been developed, the contents of which, when introduced into the skin of the human subject, have given rise to smallpox, sometimes, indeed, after the virus has been transmitted through several animals before it has been used for the inoculation of man; while a few others have succeeded in producing well-defined vesicles in the cow, the virus of which produces, when inoculated into the human subject, the usual manifestations of vaccinia. It must be borne in mind that the failure of the greater number of investigators does not invalidate the results obtained by others. Both Badcock and Ceely in England, and Thiele in Kasan, succeeded in growing definite vesicles in heifers by the inoculation of smallpox virus, and the lymph taken from these vesicles has been transmitted from child to child, producing no other results than those which follow the use of lymph taken from the vesicles of cowpox. More recently, Voigt, in Hamburg, has published successful results obtained by him in the inoculation of heifers with smallpox virus. His method has been to inoculate the animal

in the first instance with variolous matter and, immediately afterwards in another part of the body, to inoculate the same animal with cowpox. The growth of the vaccine vesicle has been accompanied by the appearance of other vesicles at the site of inoculation with smallpox virus, and the lymph taken therefrom has since been transmitted through other animals and largely used for the vaccination of human beings.

The question of the relation between cowpox and smallpox may be found in the future to have an important bearing upon the protection which is afforded by vaccination against smallpox, and it will be well, therefore, to consider very briefly the reasons which exist for regarding the two diseases as identical.

In the first instance, it may be noted that spontaneous cowpox occurs only in the female animal, and is limited to the udder and teats, man, as a rule, coming only into intimate contact with the cow and with these parts of the body during milking. Again, it is deserving of note that the horsepox appears in the horse on the part of the body which comes in most intimate contact with the hands of man, and is not limited to the female, as in the cow. Moreover, it is somewhat remarkable that spontaneous cowpox has become much less frequent in England since smallpox in rural districts has become a rare event. The simultaneous disappearance of these two affections, from country districts, points strongly to the probability that man, in some way or other, was concerned in the production of disease in the cow. Whether he merely acted as a means of conveyance of the disease from one animal to another, or whether, by becoming himself the subject of inoculation, he communicated the affection, or whether while suffering from smallpox he originated the disease in the cow, is not obvious, but that he played some part in its production there can be but little doubt. The disappearance of spontaneous cowpox from England may be explained by the fact that his condition is now altered by his vaccination in infancy, which renders him less susceptible both to subsequent cowpox and smallpox, and therefore less able to act in this capacity.

The chief argument against the identity of the virus of cowpox with that of smallpox, is the extreme difficulty with which the cow can be inoculated with the latter. In reference to this point, some importance may perhaps attach to the fact that efforts to inoculate smallpox virus have hitherto been almost limited to the use of virus taken from the general eruption of smallpox. In an unvaccinated community, the occasional inoculation of the hands of attendants on cases of smallpox must more frequently have taken place than at the present time, when vaccination is general. It may be that greater success would attend the inoculation of heifers with virus taken from the inoculated or mother vesicle of inoculated variola, the limited number of experiments at Lyons in 1865 (*Mémoires et Comptes-Rendus de la Société des Sciences Médicales de Lyon*, tome v.) not sufficiently negativing this possibility.

This question is not of mere theoretical value. If there is any foundation for the opinion, which is held by some, that the humanised lymph now generally used is less protective against smallpox than in the time of Jenner, the remedy is not necessarily to be found in the use of calf-lymph which has been transmitted through numbers of animals, but more probably in the use of lymph which has been obtained by the recent inoculation of the calf with smallpox virus. There is, indeed, no substantial foundation for the belief that the vaccine virus more naturally has its home in the bovine than in the human animal. So far a lesson is taught by the ease with which the virus can be cultivated in the one, and in the other an opposite conclusion is indicated, and, if this conclusion be well founded, the resort to calf-lymph, unless the latter be recently developed from small-pox virus, is the adoption of the shadow without the substance.

Pathology.—The experiments of Chauveau and Burdon Sanderson have proved that the virus of cowpox is particulate, and that the clear liquid which can be separated from this matter by filtration is inoperative. Microscopical examination shows that the lymph contains micrococci which may be single, in dumb-bells, or in chains. As yet these micrococci have not, after successive cultivation in nutrient fluids, been successfully inoculated into man, and this final proof is therefore wanting.

When vaccine lymph is applied to an abraded and absorbent surface in a human subject who has never suffered from variola, and who has not before been vaccinated, a growth of cells, both in number and size, accompanied by the production of intercellular fluid, takes place in the middle layer of the rete Malpighii, eventually forming cavities which are bounded by cells driven together by the fluid. At the same time the swollen cells burst, adding to the fluid in the cavities. The earlier part of this pro-

cess produces the papule, the later part producing the vesicle which is subsequently developed. The next change is the formation of a slight areola around the vesicle. The superficial areola is accompanied by an inflammation of the true skin, and the stratum lucidum becomes separated from the rete Malpighii, which in turn has developed in it a new stratum lucidum, any cellular matter above it being included in the space between the new and the old. The substance thus formed constitutes the scab, which also includes the cells lining the hair-follicles and sweat-ducts, and extending to a greater depth. The separation of the scab next takes place, the shedding of that part which is derived from the hair-follicles and sweat-glands giving rise to the foveation which is found in a normally constituted cicatrix.

Excessive inflammation will frequently lead to the destruction of the true skin, and, under these cirumstances, the foveation is necessarily absent, or the new stratum lucidum may be imperfectly formed, when exudation will continue to occur from the part which is deficient. Thus the appearance of the cicatrix may be accepted as indicating the behaviour of the vesicle, in so far as it shows not only the size of the vesicle, but the fact whether it has run a normal course.

The constitutional changes that take place are very remarkable, inasmuch as they render the individual, at any rate for some time to come, insusceptible to further inoculation. These changes are not brought about directly by the introduction of the virus into the blood, but are dependent upon the growth of the vesicle in the skin. Dr. Robert Cory has shown this by a well-devised series of experiments. Dr. Cory found that it was possible to successfully vaccinate the same child every day until the ninth day was reached, after which further inoculation became impossible. Vesicles, produced by inoculation on the later days, overtook in their development those produced by inoculation on the earlier days, so that all arrived at maturity at the same time. Thus, it was found that the subsequent course of any one vesicle was entirely dependent upon the stage of development of the first vesicle, at the time of the subsequent inoculation. A further experiment consisted of the vaccination of children having supernumerary fingers upon those fingers, and of their subsequent amputation before the vesicle had arrived at maturity. When these children were again vaccinated, a month after the amputation, it was found that the vesicles resulting ran a course which was identical with the course they would have had, if the second inoculation had taken place on the day on which the supernumerary finger was amputated, and if the amputation had not taken place; proving that the amount of protection was directly influenced by the stage of development of the first vesicle, and was arrested by its removal.

Symptoms.—The local appearances have already been indicated under the heading of *pathology*. In more detail, they consist of the formation of a papular elevation on the second or third day after inoculation, often attended by local irritation; the papule gradually increases in size, and on the fifth or sixth day becomes vesicular. The vesicle develops until the eighth day, when it has a bright pearly appearance, a depressed centre, and in the latter part of that day or the beginning of the next commences to be surrounded by an areola.

The areola increases until the tenth day, when it is usually about two inches in width, measuring from the vesicle; the vesicle then becomes cloudy, dark in the centre, and begins to scab, the areola at the same time fading. The scab usually falls about the twenty-first to the twenty-fifth day from the time of inoculation, leaving a depressed sore having a definite outline, and its surface covered with a number of minute depressions, forming the foveation which is characteristic of the vaccination scar. The general symptoms are, as a rule, but very trifling: there is often a slight increase of temperature of the body in the latter half of the first week and lasting until the seventh or eighth day, when the temperature falls, a further rise taking place about the ninth day and lasting but a few hours; in some cases there is a distinct feeling of indisposition, especially about the ninth or tenth day.

From this course there may be several departures, due to conditions peculiar to the lymph and to conditions peculiar to the child.

The vesicle may be retarded in its development, not arriving at maturity until twenty-four or forty-eight hours after the eighth day, but, apart from this, going through the usual course. Cases are also said to have occurred in which no result followed the inoculation for some weeks, but after this period vesicles eventually were formed; such cases must, however, be exceedingly rare. Other cases occasionally occur where the inoculation has apparently produced no results, but, after further

vaccination on the eighth day, vesicles appear at the site of the first inoculation. The formation of the areola is occasionally postponed or prevented by the child being under the influence of mercurial treatment. The formation of an early areola, and the more rapid development of the various stages, will result when the child has an irritable or eczematous skin, or if it has been unsuccessfully vaccinated a short time before, or when care is not taken to select lymph from vesicles running a normal course, the use of such lymph being often attended also by failure to produce any result. Such lymph will sometimes cause distinctly irritant effects; eczematous children are especially susceptible to such influences, and even when lymph is used which in healthy children produces absolutely normal results. That the lymph itself sometimes contains the elements for producing irritative results, is obvious from the fact that, of a number of children vaccinated from the same vaccinifer, several may be thus affected at the same time.

The behaviour of the vesicle in such cases is as follows:—On the eighth day there is often no abnormal appearance beyond, perhaps, the existence of a somewhat larger areola than usual; but, on the tenth day, the areola becomes extensive, spreading over the arm. At the same time, supernumerary vesicles appear in the neighbourhood of the primary vesicles, and the whole number coalesce, forming a large bleb, which scabs and constitutes a thick crust, from beneath which there is an offensive discharge, leaving eventually a deep unhealthy-looking ulcer. These symptoms are almost invariably attended by the appearance, on the tenth day, of a general eruption of *vaccinia lichen*, to be hereafter described. In the latter part of the second week, fugitive patches of erythema occasionally appear on the extremities and other parts of the body, and may be mistaken for erysipelas, which they somewhat resemble. Lymph may, however, show its irritative qualities at an earlier date than this; thus, there may be on the eighth day a large areola, the vesicles at the same time being broken and discharging freely a serous fluid. Such cases can, however, only result when every regulation for the selection of proper lymph for vaccination is disregarded.

The vaccine vesicle, and especially in children with irritable skins, occasionally differs in other respects from normal vesicles: thus, the vesicle may never fully develop, but, while spreading from the edges, is flat and depressed, and has a grey-brown appearance; it does not properly scab over, but the scab becomes detached piecemeal, leaving an unhealthy indolent sore, which is often of considerable duration before cicatrisation finally takes place, the surface later becoming sometimes covered with large granulations, which rise up above the level of the skin and exude moisture. A further irregularity may occur, at the time of separation of the normal crust, by the formation of another from the discharge of the surface beneath; under these circumstances, the second crust will remain an indefinite time and often has eventually to be removed by poulticing.

Treatment.—The normal vesicle requires no interference. The day after the inoculation has taken place, the surface may be sponged gently to remove any coagulated blood which may have collected at the site of operation. After this, it should be protected by a soft piece of clean linen, and every care taken to prevent injury from rubbing and scratching. Shields should never be worn; they constantly become displaced, and by pressure often interfere with the circulation. It is not uncommon to find them used for one case after another, and thus they become soiled with animal matter and are a very possible source of danger. Poulticing and moistening the vesicle should be avoided; this practice interferes with the natural process of scabbing, and poulticing frequently leads to the whole vesicle sloughing out, leaving a deep ulcer. In cases where the crusts have run together and a thick mass is formed, sufficient time should be given to allow this to separate; if, however, the separation is unduly delayed, and at the same time an offensive discharge escapes from beneath, the whole should be poulticed until the crust separates, and the remaining ulcer dressed with lint and zinc ointment. When the scab has either not formed properly or has separated prematurely, leaving an unhealthy-looking ulcer, zinc ointment dressing will be found to answer exceedingly well.

Eruptions.—The vaccination of infants is occasionally followed by cutaneous eruptions. Those most common are *roseola* and *vaccinia lichen*, occurring usually from the seventh to the tenth day after vaccination. The former appears in slightly raised erythematous patches over the chest, back, and extremities, but in the course of a day or two the eruption fades. Vaccinia lichen also appears about the same time, usually, and is often associated with the roseolous rash. It appears in the form of numerous

minute papules on the face, chest, back, and the front of the limbs; often the papules become vesicular, resembling the vesicular rash which occasionally occurs in scarlatina. In most cases the eruption lasts but two or three days, and then gradually fades; in certain exceptional cases the vesicles on the foot and face become much increased in size, and are somewhat persistent. Later erythematous blushes have been already alluded to. Eczematous rashes are also occasionally produced, usually from the seventh to the tenth day after vaccination, in eczematous children, the fissures behind the ears, which are often found in such children, at the same time increasing and discharging serous fluid.

Syphilitic children in their turn may suffer from syphilitic eruptions. Vaccination-Syphilis is treated of later on, but it may be stated here that the inoculation of syphilitic virus at the time of vaccination does not immediately show itself, but usually, after the scab has formed, some ulceration takes place at the site of the cicatrix, and later the specific eruption makes its appearance. Apart from this, however, specific eruptions occasionally appear about the tenth day after the vaccination of a previously syphilitic child. In these cases there is no special appearance about the vesicle, which runs a normal course. The vaccination has simply been the occasion of the appearance of the symptoms. The writer holds that the lymph may be eliminated from suspicion, as the same event will equally occur after the use of calf-lymph. Erysipelatous eruptions may result from the inoculation of erysipelatous matter at the moment of vaccination, or later when the vesicle is opened for the collection of lymph; or it may occur at any time if the vesicle be broken and the child exposed to the infection of erysipelas, even at the time of the separation of the crust, should the subjacent tissues be not entirely healed.

These eruptions may be treated on general principles, altogether apart from any consideration of the fact that the child has been recently vaccinated.

Selection of Lymph.—Lymph, which is intended for vaccination, should be taken from vesicles not later than the eighth day after inoculation—i.e. on the day week of operation—and only from perfectly healthy infants having a good family history. The child should be carefully examined as to physiognomy, skin-eruptions, snuffles, and all other signs of syphilis, the buttocks and arms should be inspected, and any appearance which gives rise to the least doubt or suspicion should be a reason for the lymph being condemned. Lymph should only be taken from the primary vaccination vesicles of infants, and never from older persons or from any child undergoing re-vaccination. The vesicle should have run a normal course and be normal in appearance, clear, pearly white, and no lymph should be taken if any one of the other vesicles is broken or is abnormal in appearance. There should be but little areola. It is commonly recommended that lymph should only be taken from vesicles absolutely without areola; but this rule has been departed from by experienced vaccinators, who do not discard a vesicle on account of a commencing areola. Indeed, the best results are often obtained when there is an areola which is of limited area, of a bright colour, and when it is accompanied by the appearance of slight papular elevations, which may occasionally be interspersed with minute vesicles on the surface surrounding the vesicle.

While the general rule must be laid down that the lymph should be perfectly clear and translucent, it must be admitted that cloudiness may exist, which does not interfere with the production of perfectly normal vesicles; lymph which flows rapidly should be distrusted, it is often of poor quality and likely to lead to failure. Too much lymph should not be collected from any one vesicle; as the lymph exudes from the vesicle after puncture, it is sometimes replaced by serum, which necessarily dilutes the virus, and it is therefore well to abide by the official recommendation: 'From such a vesicle as vaccination by puncture commonly produces, do not, under ordinary circumstances, take more lymph than will suffice for the immediate vaccination of five subjects, or for the charging of seven ivory points, or for the filling of three capillary tubes; and from larger or smaller vesicles take only in like proportion to their size. Never squeeze or drain any vesicle.'

Precautions as to Vaccinee.—The best age for the vaccination of infants is before the beginning of dentition; the law, therefore, wisely requires the vaccination of children before the end of the third month, but there is no reason why it should not be performed earlier. There does not appear to be any special risk attaching to the vaccination of infants only a few days old, nor is this early period a reason for vaccinating less efficiently than at a riper age. Except in cases where there is im-

mediate risk of exposure to infection of smallpox, only healthy subjects should be vaccinated. The child should, therefore, be in good health and free from any sign of eczema, such, for instance, as fissures behind the ears. No child should be vaccinated who is exposed to contact with any of the acute infectious diseases but smallpox, and the infection of erysipelas should be especially avoided.

Method of Operation.—A great variety of instruments have been invented for the inoculation of vaccine lymph. It is unnecessary to describe them in detail: many are constructed with a groove which is intended to hold the lymph, and to give opportunity for its better introduction at the moment of incision. It must be remembered that any such irregularity of the surface serves also to retain other matter, and to interfere with the proper cleanliness of the instrument; such apparatus should, therefore, not be used. There is no better instrument than an ordinary bleeding lancet, which is not too sharp. The sharper the blade, the greater will be the hæmorrhage resulting from its use; and excess of bleeding is not only on sentimental grounds to be avoided, but it has also a tendency to wash out the lymph. The only appliances which are necessary are the lancet, a clean napkin, and a small basin or glass of water. In the performance of the operation, the vesicle of the vaccinifer should be carefully punctured in a number of places, the greatest care being taken to avoid the drawing of blood. Should there be the least appearance of blood in the lymph which exudes, the vesicle should be abandoned, and the lancet carefully cleaned.

Assuming no such accident to happen, a globule of lymph should be taken upon the point of the lancet, the arm of the vaccinee should be firmly grasped by the left hand of the operator, the skin of the child at the site of inoculation being stretched between his fingers and thumb. The lymph may be inserted by puncture, by a series of scratches, or by both methods. At the moment of puncture the lancet should be half-turned, so that the edges of the blade open the small wound which has been made, and, during scratching, the blade should not be held at right angles to the skin, but obliquely, in order that a larger amount of absorbent surface may be produced by each scratch. The amount of surface to be covered by the scratching must necessarily depend upon the size of the vesicle it is intended to produce. Lymph from more than one vaccinifer should never be used for the vaccination of the same child. A caution is needed as to the mode of transference of the lymph from the vaccinifer to the vaccinee. The lancet should be charged with sufficient lymph to enable the operation to be completed without the necessity of returning to the vaccinifer for more. Should, however, this necessity arise, the lancet should be dipped in the water and carefully wiped, to prevent communication to the vaccinifer of any blood or other matter from the vaccinee, where it might not only cause injury to the vaccinifer, but to other children vaccinated from him. In direct arm-to-arm vaccination, ivory or bone points should never be used for this purpose instead of the lancet. They can never be properly cleaned, but are liable to retain animal matter about them, and have indeed been a potent source of mischief.

If lymph is about to be used which is stored in capillary tubes or on ivory points, the procedure is necessarily a little different. If stored in tubes, both ends should be broken off, and the lymph blown on to the point of the lancet and immediately inserted. If stored in points charged with humanised lymph, it is sufficient to rub the point over the excoriated surface, the blood which is drawn providing enough moisture to remove the lymph from the point. In the case of points charged with calf-lymph, it is desirable to dip the charged end, which adheres more firmly to the ivory, momentarily into water, to shake off immediately the superfluous moisture, and to allow the point to remain for a few minutes before it is rubbed over the surface.

The important question of the size and number of the vesicles which must be produced has to be considered. There is too much tendency at the present time to forget the sole object of vaccination—the protection against smallpox—and to consider only the requirements of the law, which does not specify the details of size and quality of the vesicle. The duty of the practitioner is obviously to vaccinate in such a manner that the infant shall be protected, if possible, for life, and certainly until it has arrived at an age when it can decide for itself whether the protection shall be renewed. To yield to the oft-made suggestion of the mother to vaccinate the child in few places, is to be guilty of a breach of duty to the patient. The production of one small vesicle will undoubtedly render the child absolutely insusceptible to smallpox, but for a time only; the return to susceptibility occurs

more rapidly than when the vaccination is more efficient. The statistics of every smallpox hospital, which have been tabulated, tell the same story, that the severity of attack and mortality from smallpox occurring in vaccinated persons is inversely proportionate to the number and quality of the vaccination cicatrices. The official memorandum, *Instructions to Vaccinators under Contract*, recommends: 'In all ordinary cases of primary vaccination, if you vaccinate by separate punctures, make such punctures as will produce at least four separate good-sized vesicles, not less than half an inch from one another; or, if you vaccinate otherwise than by separate punctures, take care to produce local effects equal to those just mentioned.' Again, the award to public vaccinators, for vaccination of the first grade, is only given when the scars produced are well-marked in their foveation, and have collectively at least half a square inch of total area.

It is, however, necessary to ascertain whether the same amount of protection is afforded by a vesicle producing one large cicatrix as by several which together cause a smaller cicatricial area. The data upon which an opinion can be expressed is not yet sufficient for such opinion to be very definite; but a lesson may perhaps be learnt from the behaviour of the vesicle, in revaccination of persons whose primary vaccination in infancy was of such a character as to leave one large cicatrix having a large superficial area, and comparing these results with the behaviour of the vesicle in revaccination of other persons whose primary vaccination produced three small vesicles, leaving cicatrices whose aggregate did not exceed the area of the one large cicatrix.

Results of Revaccination of Persons aged from Ten to Thirty Years.

	Cases in which the areola of the revaccination declined on the eighth day or earlier, and were therefore further removed from condition of complete susceptibility	Cases in which the areola of revaccination declined after the eighth day, and therefore more nearly approached complete susceptibility
Possessing one primary vaccination cicatrix having a diameter of five-eighths of an inch or more	11, *or 48 per cent.*	12, *or 52 per cent.*
Possessing three primary vaccination cicatrices each having a diameter of three-eighths of an inch or less . .	119, *or 67* „	58, *or 33* „
Possessing one primary vaccination cicatrix having a diameter of half an inch or more.	17, *or 53* „	15, *or 47* „
Possessing three primary vaccination cicatrices each having a diameter of a quarter-inch or less	49, *or 75* „	16, *or 25* „

It will be seen by the above, that the protection afforded by primary vaccination has lasted longer where the cicatrices are numerous and small, than where there is but one large cicatrix. The numbers on which the percentages are calculated are undoubtedly small, but there is, nevertheless, sufficient uniformity in the result to warrant the belief that one large vesicle will protect less than three smaller vesicles, although the aggregate cicatrices of these may be smaller than the cicatrix of the one large vesicle.

The writer does not propose to theorise upon this point; it is sufficient to state, for practical purposes, that not less than four vesicles should be produced, the combined resulting cicatrices of which would not be less than one half of a square inch in area.

To ensure that the operation shall successfully produce these results, the vaccination should always be done, when possible, directly from arm to arm, and without resort to the use of stored lymph. Arm-to-arm vaccination in the hands of a good operator will be attended by the production of not less than 97 or 98 vesicles in every 100 insertions, while the use of stored lymph will reduce this success by 25 or 30 per cent. In thickly populated communities, no difficulty will be encountered in vaccinating, week by week, from the arms of children inoculated during the previous week; but in more sparsely inhabited districts, where

but three or four children would be vaccinated every week, it is better not to attempt to carry on weekly vaccination throughout the whole year, but to do so only during some portion of the year, so as to ensure a larger number of vaccinations on each day. It is often necessary, under these circumstances, to resort to stored lymph for the purpose of beginning the series, but its use should be limited to this object.

Revaccination.—When a person is vaccinated, complete protection is afforded against smallpox. Of this the best evidence is, that it is impossible to produce any result by the subsequent inoculation of the smallpox virus, but, as time goes on, there is a gradual return to susceptibility. This is particularly well shown in the effect which the vaccination of persons at the time of infancy has had upon the ages of death from smallpox. In pre-vaccination times, the majority of children born were attacked with smallpox before reaching the age of four years, and, after a terrible loss of life, the majority of the remainder were left protected by this attack from subsequent attack. Vaccination does not appear to produce such permanently protective results as smallpox, and, hence, the diminution of death from smallpox in early life, which has resulted from vaccination in infancy, has been attended by an increasing death-rate from smallpox amongst people of the later period. This is best shown by the following table, which is extracted from the *Forty-third Annual Report of the Registrar-General of Births, Deaths, and Marriages in England*, and which illustrates the period of life at which vaccinated and unvaccinated people respectively die from smallpox.

Proportion of deaths under and over fifteen years of age per 1,000 *deaths from smallpox, in vaccinated and unvaccinated persons respectively :—*

Age	Unvaccinated	Vaccinated
Under fifteen	672	334
Over fifteen	328	666
	1,000	1,000

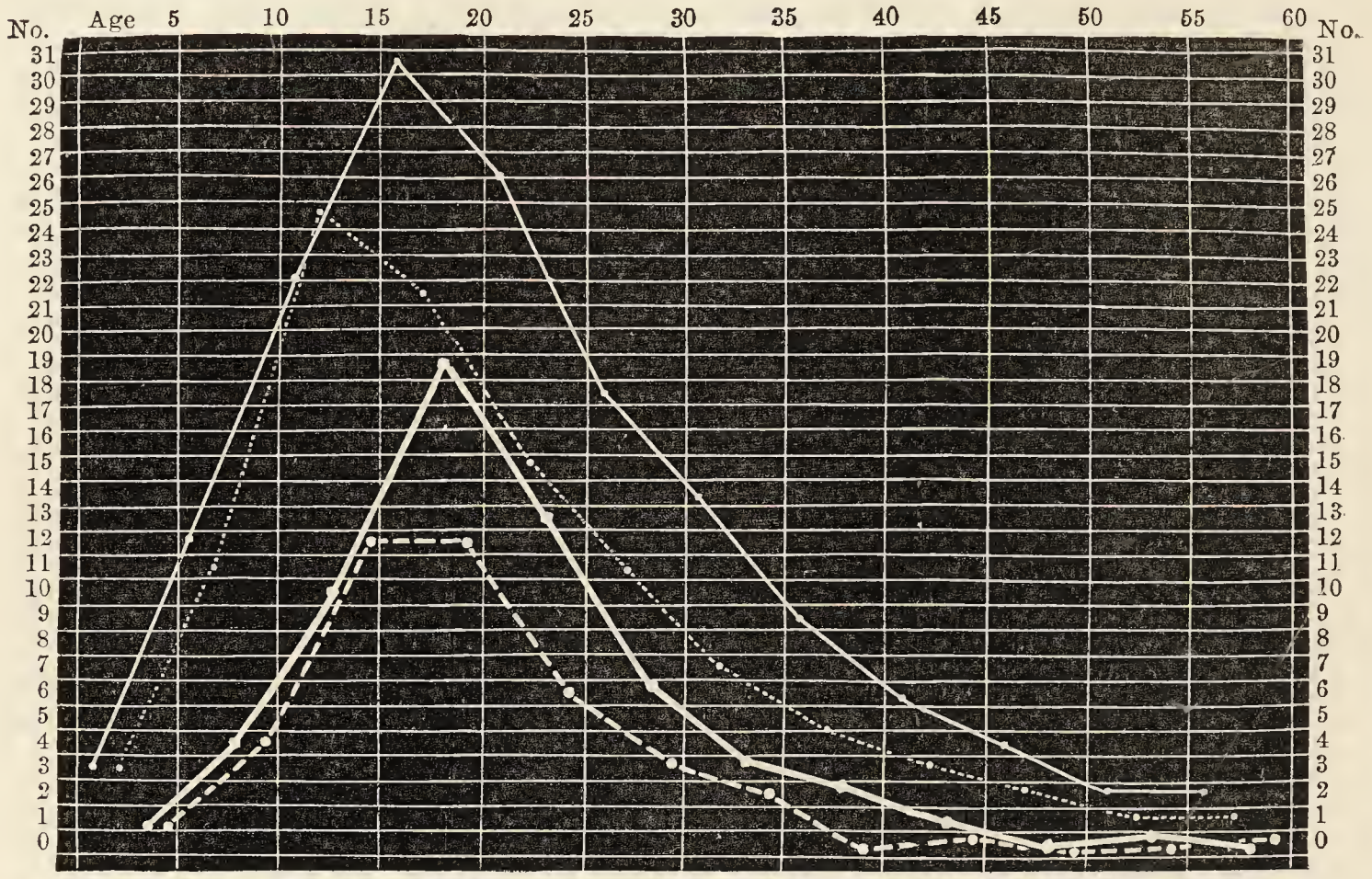
The question necessarily arises during how long a period does vaccination afford protection, for it is obvious that protection can be renewed by revaccination.

There is no doubt that this must, to some extent, depend upon conditions peculiar to the individual, but is also dependent in a very important degree upon the character of the first vaccination. This is shown by the evidence derived from smallpox hospitals, which proves that the severity of illness of a person, suffering from smallpox, and the probabilities of death are dependent upon the number, size, and quality of the vaccination cicatrices, and the interval which has elapsed between the time of vaccination and the attack of smallpox. In this connection may be cited the statistics of Collie, Gayton, McCombie, and Marson, the three first published in the reports of the Metropolitan Asylums Board.

A lesson may also be learnt from the number of persons admitted into the smallpox hospitals with good and indifferent vaccination-marks, and for this purpose it will be sufficient to study the statistics of Dr. Gayton, which relate to the cases which came under his personal observation. The writer of the present article has constructed from these statistics the following diagram, which represents the number of males and females, with good and indifferent primary vaccination cicatrices respectively, at each quinquenniad of life in each 1,000 of total admissions which were received into the hospital.

The numbers have been corrected with a view to showing what is the effect upon equal populations at each age period, and it has been assumed that the numbers of persons with good and indifferent marks in the population have been equal. As a matter of fact, the number of persons with good marks is in excess of those with indifferent marks; but inasmuch as the proportion between the two is not accurately known, it has been thought better to regard them as equal. But it may be borne in mind that in reality the diagram shows, in consequence, an exaggerated number of admissions with good marks in proportion to those with indifferent marks, but the diagram as regards males and females of each class is probably strictly comparable (p. 764).

It may be assumed for all practical purposes that the community is vaccinated, better or worse, shortly after birth, and that the increasing number of admissions, as time goes on, is due to the gradual return of these persons to a condition of susceptibility to attack from smallpox. It will be observed that, after ten years has passed, females return to this condition somewhat more rapidly than males, and that some circumstance comes into effect between ten and twenty years which checks and diminishes this increasing susceptibility. This is undoubtedly chiefly due to revaccination, but also in part to attack from smallpox; and the fact that the in-



Top line shows number of males with indifferent primary cicatrices.
Second line shows number of females with indifferent primary cicatrices.
Third line shows number of males with good primary cicatrices.
Fourth line shows number of females with good primary cicatrices.

creasing susceptibility of women is checked at an earlier age than that of men must be mainly caused by these influences.

It is within the power of revaccination entirely to check this growing susceptibility, and the diagram shows that in no instance should revaccination be delayed after fifteen years of age, especially in those cases where the vaccination cicatrices are indifferent in character. Revaccination before ten years of age would largely reduce liability to attack from smallpox, and still better results would doubtless follow if revaccination, performed at this earlier period of eight or ten years of age, were repeated shortly after puberty. Whether this would permanently protect against all attack from smallpox for the rest of life must remain doubtful; and it is obvious that it is better to adopt the recommendation of the German Vaccination Commission and resort to revaccination during each subsequent ten years of life, and, if there be definite exposure to smallpox, that the operation should not be delayed till the end of this period.

The local manifestations of revaccination usually differ from those of primary vaccination. The individual is already, as a rule, partially protected against cowpox and smallpox, and the results of inoculation have only to make up the differences between the amount of insusceptibility already obtained and total insusceptibility. In some persons, the susceptibility which remains after primary vaccination is so slight as to need only the development of papules, which last but a day or two, and then fade, or the development of vesicles may be required to give the additional protection which is needful to produce complete insusceptibility. The local manifestations of revaccination may, therefore, be little more than mere irritation—the production of a vesicle which rapidly runs through its course, becomes pustular, and is surrounded by a crust during any period of the latter part of the first week, or early in the second week; or again, of a vesicle which runs the same course as that of primary vaccination.

There is frequently seen more œdema of the arm and a larger extent of areola in revaccination than in primary vaccination; but this is probably due to the fact that in revaccination the areola generally develops earlier, and is therefore more extensive on the usual day of inspection.

Preservation of Vaccine Lymph.—The most common methods of preservation of lymph are in capillary tubes and on ivory points. For the purpose of collection in the former, the end of the tube is inserted

into the bead of lymph which exudes after puncture of the vesicle, and the tube being held obliquely or horizontally, the lymph rapidly rises. When one-third of the length of the tube is filled, the lower end, which is in contact with the vesicle, is raised and the lymph allowed to gravitate to the centre. The moistened end of the tube is then heated in the flame of a spirit lamp, the part containing the lymph being protected by being covered by the finger and thumb holding the tube, so as to prevent the lymph from becoming coagulated or damaged by the heat; the tube thus becomes coated with charcoal, which must be burnt off in the upper part of the flame before the tube will close. The end of the tube is then melted and the tube closes; the other end is next taken between the finger and thumb, the lymph being protected in the same way. The tube is rapidly passed through the flame from the end up to the point where it is held, and, the air having been expanded and partially expelled by this means, the end of the tube is melted and closed. The fact that the tube is hermetically sealed is assured by the collapse of the melted end of the tube.

The preservation of lymph on ivory points is effected by collecting a bead of lymph on the end of the point and exposing it to the air until it has become dry. The lymph should cover the flat surface of the point as well as the extremity, and the point should preferably receive two coatings. In drying it, care should be taken that the moist surface does not come in contact with any substance which can impart dust to it. The points should be afterwards stored in close bottles. A third but less frequently adopted method of preserving lymph is by means of small square pieces of glass. The centres of two pieces of glass are brought in contact with the punctured vesicle, and the lymph is thus transferred to it. The glasses are then brought face to face with the moistened surfaces in contact with each other, and the edges are sealed by dipping them in melted paraffin. A fourth method is the preservation of undried lymph in bottles. This, however, cannot be recommended, as the lymph is very liable to decompose, and its use is attended with some risk unless but very few hours intervene between its collection and subsequent inoculation. The admixture of lymph with glycerine and with a solution of thymol or other preservative is also practised, but the data for comparing the advantages of one method over another are not sufficiently great to warrant any other recommendation than that lymph should be preserved either in tubes or on points, as already described.

For immediate use—i.e. within a week after collection—the method of storage on ivory points is most to be depended upon. The preservation of lymph in tubes is less frequently attended by good results, most probably because of the tendency of the particulate matter to adhere to the sides of the tubes than of any alteration in its composition. For longer intervals of some weeks, tubes produce somewhat better results than points.

Animal Vaccination.—The cultivation of lymph in the calf differs from the cultivation in the human subject chiefly in the circumstance that in the calf only one hundred and twenty hours, or five times twenty-four hours, are required for the full development of the vesicle, while in the human subject one hundred and sixty-eight hours, or seven times twenty-four hours, are required for this purpose, a fact probably due to the higher temperature of the calf, which is usually from 100° to 102° Fahrenheit. The method adopted for the inoculation of the calf is as follows: A calf, which should be from three to six months of age, is placed on a table constructed so that the animal's hind legs can be separated, exposing the abdomen. This part of the body, the perineum, and flanks are shaved, and the surface cleansed by washing with a solution of carbolic acid. The lymph (which is preferably collected at the same moment from another calf) is taken on to the upper side of a rather blunt tenotomy knife, and a number of incisions, usually seventy or eighty, are made with this knife in the skin, but not through the skin; the incisions should be about an inch in length and arranged in lines, an interval of an inch being left between the successive rows, and the knife being charged with more lymph from time to time. Another method is to inoculate the calf by puncture with a small barbed instrument, grooved so as to better hold the lymph. The animal is then returned to the stable, and is provided with a collar in order to prevent it from licking the vesicles. After forty-eight hours, a papular elevation appears at the site of each inoculation, and at the end of another thirty-six hours these become vesicular, the vesicles being sufficiently developed on the fifth or sixth day for use for the vaccination of other calves or children. On the latter of these days an areola forms; lymph may, however, be taken for the same purposes after another twenty-four hours, but later it is purulent and unfit for use.

The pustules scab over, and fall between the fifteenth and twentieth days.

Lymph cannot be collected in the same manner as from the human subject. It is necessary to squeeze the vesicle, and for this purpose curved forceps with a sliding catch are used. The pressure on the vesicle ruptures it and the clear lymph exudes, and may be collected on the knife for immediate use, and on points or in tubes, as in ordinary vaccination. Animal lymph ordinarily produces in the child the same symptoms as humanised lymph. In calf-vaccination there is, however, not the same opportunity for selecting the vaccinifer from a number as occurs when humanized lymph is used, and hence calf-lymph is perhaps a little more variable in its results. It has been found, too, in the hands of some vaccinators, that if calf-lymph be introduced into a station, and used for renewing the stock, the first few children of the series have less regular results. How far this may be due to the use of lymph obtained from Continental stations, where it is collected after a less definite period than in England, is not known, for other operators have found no such results from the use of lymph cultivated in this country, where the rule is to collect lymph one hundred and twenty hours after inoculation.

By the use of calf-lymph the possibility of inoculation of syphilis is eliminated, and the risks of erysipelas reduced by the fact that it becomes unnecessary to open the vaccine vesicle of the infant for the purpose of procuring lymph for carrying on operations. Apart from this, however, erysipelas may occur, as after every wound of the surface.

The fear of inoculation of tuberculous matter by the use of animal lymph need not be entertained. The experiments of Acker tend to show that tubercle does not exist in the vaccination vesicle of tuberculous subjects, while the experiments of Josserand at Lyons confirm this opinion. There is, moreover, the important fact that at Brussels it is the rule to examine the bodies of all calves which have been previously used for vaccination purposes, and in no single instance has tubercle been found in these calves, although some thousands have been examined. Again, in Würzburg, in the slaughterhouse, of 150,000 calves not one was found to be tuberculous. It is thus quite possible to eliminate any risk of tubercle by the selection for vaccination purposes of healthy calves in good condition. The chief disadvantage of calf-lymph is the expense involved in its production, leading to the limitation to large centres of population of direct vaccination from calf to arm. Sparsely inhabited districts would necessarily have to depend upon the use of stored lymph, and, as a result, vaccination would be performed with less efficiency than is now possible when arm-to-arm vaccination is practised. Direct calf-to-arm vaccination of infants produced in the London Animal Vaccine Station during 1884, in the hands of two operators, 985 and 991 vesicles for every 1,000 of insertions which they respectively made. The use of stored lymph materially reduced this success. There is not, however, any positive ground for the statement that the keeping powers of calf and humanized lymph differ from each other. The experience of the above-named institution fails to show that such difference exists.

Vaccination Law.—In the year 1841 an Act was passed enabling every person to be vaccinated at the public cost, and in 1853 it was rendered compulsory, under a penalty of twenty shillings, that every child born after the passing of the Act, should be vaccinated, and should be brought back for inspection, under a further penalty of twenty shillings. In 1858 officers were empowered to be appointed to conduct proceedings before justices under the Acts relating to vaccination, and in 1867 a further Act was passed which repealed nearly the whole of the previous legislation, but re-enacted the chief provisions.

By the Act of 1867, unions and parishes were to be divided into vaccination districts, subject to the approval of the Poor Law Board, and the guardians were to contract with a duly qualified medical practitioner for the performance of vaccination of all persons resident within each district; the vaccinator appointed was required to possess such qualifications as were prescribed by the Lords of the Privy Council.

Other provisions were an authority for the payment of a sum not exceeding one shilling for every child successfully vaccinated, in addition to the sum paid by the guardians; the scale of fees to be paid by the guardians was not less than one shilling and sixpence, for every vaccination done at an appointed station situated at or within one mile from the residence of the vaccinator or in the workhouse of the Union; for every vaccination done at any station over one mile and under two miles distant from his residence, not less than two shillings; and for every such vaccination done at any station over two miles distant from his residence, not less than

three shillings, such distance being measured according to the nearest public carriage road; but in respect of successful vaccinations performed elsewhere than at a station or in the workhouse as aforesaid, the payment to be according to the terms specified in the contract as approved by the Poor Law Board. The fee for the revaccination of persons who may apply to be revaccinated, the Poor Law Board having issued regulations in respect thereof, to be two-thirds of the fee payable for each case of primary vaccination. No contract to be valid unless approved by the Local Government Board. The public vaccinator cannot charge for the vaccination or revaccination of any person not resident in his district.

In sparsely-populated districts, the guardians may arrange for public vaccination every three months, and no parent is to be liable for neglect to procure the vaccination during this interval, if the omission is due to the fact that the vaccination cannot be performed on account thereof.

The provisions for ensuring the vaccination of a child are the delivery of a notice by the registrar to the parent or other person having the custody of the child at the time of registration of birth, requiring the child to be taken to the public vaccinator within three months of birth for the purpose of being vaccinated, and to again take the child on the day week to him for inspection, and for him, if he sees fit, to take lymph for the performance of other vaccinations. In the event of a child being unfit to be vaccinated, a medical certificate to be necessary to postpone the vaccination for a period of not more than two months without renewal of the certificate. Children who have had smallpox, or who have been unsuccessfully vaccinated three times, to be exempt, on medical certification of either fact. The public vaccinator to sign the certificate, and, if required, to give a duplicate to the parent, and to forward the former to the registrar in whose district the vaccination shall have been performed; if the operation have been performed by a medical practitioner not being a public vaccinator, the certificate is to be forwarded to the registrar by the parent. The parent is to be liable to a penalty not exceeding twenty shillings for neglect to procure the vaccination of a child, and the public vaccinator and parent to be liable to the same penalty for neglect to perform their respective duties as to forwarding the certificate. Justices may make an order for the vaccination of a child under fourteen years of age not previously vaccinated, and any neglect of the parent to comply with the order shall render him liable to a penalty of twenty shillings. Previous notice must be given to the parent. Any person signing a false certificate to be guilty of a misdemeanour. Inoculation of smallpox is forbidden, under a penalty of not more than a month's imprisonment.

By the Act of 1871, vaccination officers are empowered to be appointed to undertake such duties previously devolving upon registrars and others; they are to receive from the registrar lists of births and deaths in his district. When a revaccinated person fails to reappear for inspection, he shall pay a fee to the guardians of two shillings and sixpence. The penalty for not producing a child, when required by a summons under the Act, is payment of a sum not exceeding twenty shillings. Complaints to be made and information to be laid for offences under the Vaccination Act within twelve months from the time when the matter of such complaint or information arose, and not subsequently. When a child has been successfully vaccinated by some one else, the public vaccinator, on the request of the parent, and after personal examination, may certify to this fact. When the Poor Law medical officer is in attendance as such upon a person suffering from smallpox, he may charge for the vaccination and revaccination of other persons in the house, as if he were a public vaccinator.

SHIRLEY F. MURPHY.

VACCINATION-SYPHILIS.—There is unfortunately no longer the least room for doubt that the pellucid lymph of a vaccine vesicle may contain the contagium of syphilis. It is not a necessary condition that blood should be drawn, or that the vesicle should be allowed to 'drain,' for if the vaccinifer be syphilitic, no precautions in these directions will give security. In saying this, it is by no means implied that such precautions are valueless; probably they are far otherwise, but they do not remove risk. Long after all doubt was past as to the possibility of conveying syphilis by vaccination, there seemed reason to hope that it could occur only when the lymph was mixed with blood or with fluid which, by draining after the vesicle was emptied of its original contents, had recently transuded from the tissues or blood-vessels. We are now, however, obliged to face the fact that these accidents are not essential, and that the virus may exist, in full potency, in lymph which is per-

fectly clear, and which has been taken with the utmost care. We owe this melancholy advance in our knowledge to the self-sacrificing enthusiasm of a public vaccinator, who repeatedly tried the experiment on himself. He selected vaccinifers who were suffering obviously and severely from inherited syphilis, and in three instances he failed, but in the fourth he succeeded. In this last experiment he produced, on his own forearm, three indurated chancres, which were followed in due course by complete syphilis. Since the greatest care was taken to use only clear lymph, and the whole details of the experiment were under the observation of skilled observers, no more evidence on this point can possibly be desired. Men engaged in the practice of vaccination have in future to realise that, under no conditions, are syphilitic vaccinifers safe, and must devote their efforts at prevention almost solely to the exclusion of such subjects from use.

In some respects it is well that the facts should have been thus simplified. If, at first sight, it may seem that the area of danger is enlarged, we may, on the other hand, feel confident that safety comes with knowledge. The open and complete removal of supposed grounds for security, which were wholly untrustworthy, can only result in reduction of risk. All that is necessary is that the facts should be made widely known.

When the syphilitic virus is conveyed in vaccine lymph, the behaviour of the sore may present certain variations. As a rule, however, with but few exceptions, if the vaccination takes, the vesicle passes through its stages and heals in the usual manner. Nothing is suspected until, at the expiration of probably about five weeks, the scar becomes irritable, and in the course of a few days enlarges into a little papule. In another week it will be hard, and subsequently will, in most cases, present all the usual features of an indurated sore. In some cases the scar may inflame in less than five weeks, but very rarely in less than a month. It does not make any difference whether the vaccination has taken or not. In each instance, the first signs of irritation in the site of the puncture occur at the same time. If it have not taken, then it is possible that all trace of a puncture may have disappeared before the syphilitic inflammation commences. When once an indurated chancre has developed, its subsequent progress will depend upon the treatment and the proclivities of the individual. If mercury be given early, the sores will soon disappear, and but few evidences of the secondary stage will probably be witnessed. If mercury be not given, the sores may enlarge indefinitely, and perhaps coalesce, and may be attended by a good deal of inflammation. In rare cases, phagedæna may occur. Almost always there are enlarged and hard glands in the armpit, and these scarcely ever suppurate. There is no reason to believe that the virus of syphilis is ever absorbed after vaccination without the intervention of a local chancre; and, usually, the conditions of the latter are very definite, and leave no room for error. If vaccination-vesicles have passed through their stages, dried up, disappeared, and nothing more has occurred, it may be assumed as certain that there has been no introduction of syphilis. It is not without exception that an interval occurs between the healing of the vaccination vesicle and the development of syphilitic changes in its site. In some cases the sore remains unhealed throughout, and it may be acutely inflamed. In such we must suppose thut pus-elements, in addition to the specific virus, have been introduced.

The constitutional phenomena after vaccination-syphilis do not differ in any respect from those of the disease when obtained in other ways. Nor is there any difference in the rules as to treatment. If mercury be given early, the primary phenomena soon disappear, and it is exceptional for any of the secondary stage to be witnessed. Some of the series of cases of syphilis after vaccination have offered unusually good opportunities for observing the laws of development of this malady, since it was known to be conveyed from the same source to many individuals at the same time. Observations on series of this kind lead to the belief that its stages, more especially that of incubation, are more uniform in duration than had been generally believed. It appears that the interval between contagion and the first signs of morbid action is very rarely less than a month, and definite induration is seldom produced till near the end of the fifth week.

It is probable that the virus of syphilis is not always present in the vaccine lymph of syphilitic vaccinifers. When it is present, it may show its vigour by producing chancres in almost all those vaccinated, and in almost all the several punctures made in each person. Multiple chancres are the rule under such conditions, and usually more punctures are infected than

escape. Yet, with such facts before us, we find that it is possible to vaccinate intentionally from syphilitic infants repeatedly with effect. No doubt this has been done unwittingly in many cases, and we may believe with confidence that it is only in exceptional instances that syphilis is communicated by vaccination, even when tainted children are used. Nor does the risk seem to be in relation with the apparent severity of the disease in the child. In two of those employed in the experiment just mentioned the disease had induced much cachexia, whereas in one of those from which a whole series of infections resulted, the vaccinifer appeared to be in excellent health.

In the all-important matter of the selection of a vaccinifer, the surgeon should carefully examine both the child and its mother, unless, indeed, he be already well acquainted with the family history. The child's nates and anus should be inspected, since sometimes eruptions or even condylomata are present on those parts in children apparently free from disease. By care in this matter, the risk may be reduced to a minimum ; but it must still be admitted to be possible for both mother and child to be free from any suspicious symptoms, whilst syphilis is yet present. It is well, therefore, to adopt the rule of never employing a first-born child. If there be one or more healthy elder children, and the child itself and its mother are free, then it may be regarded as practically certain that no taint exists.

Although vaccination-syphilis is a reality, and unquestionably demands our utmost circumspection for its prevention, yet it is fortunately very rare. Since the several series of cases which the writer recorded about ten years ago, not a single instance of it has come within his knowledge, nor have any been mentioned to him by his professional friends.

JONATHAN HUTCHINSON.

VAGINA, Affections of the. — The vagina, extending from the vulva to the uterus, is lined by mucous membrane continuous with the investment of the external organs of generation. Anteriorly, the canal is intimately united below with the urethra, and above with the base of the bladder (*vesico-vaginal septum*) ; while, posteriorly, it is connected more or less closely below with the anterior surface of the rectum (*recto-vaginal septum*), but lies for the upper third of its extent in immediate relation to the peritoneum lining Douglas's space. The *vulvar orifice*, which is the narrowest part of the vagina, is partially closed in the normal virgin state by a membranous structure termed the *hymen*, of which the remains after rupture constitute the tubercles known as *carunculæ myrtiformes*, found seated around the entrance of the canal.

I. MALFORMATIONS, whether congenital or acquired, owe their chief clinical importance to the obstruction which may be offered to the free escape of the menstrual fluid. But, short of this, they may interfere with coitus, or even impede the passage of the child in the event of pregnancy and labour.

1. *Congenital malformations* resulting from defective development, or from subsequent closure during fœtal life of a part of the canal by inflammatory processes :— *Complete absence of the vagina* is an extremely rare condition, usually although not invariably associated with imperfect development of the uterus and ovaries, and hence less likely than some other minor malformations to call for active surgical interference. *Septate* or *double vagina* is another deformity of very rare occurrence, characterised by the existence of two distinct canals separated by a more or less complete vertical septum, and often communicating with a bifid uterus, of which one horn is commonly more developed than the other. *Partial occlusion* (*atresia*) of the vagina may be due to an obstruction seated in the upper or middle third of the canal, or more frequently immediately within the orifice. But the most common form of occlusion is that known as *atresia hymenalis*, from the presence of an imperforate hymen.

2. *Acquired malformations*, resulting from cicatricial bands or septa, may present almost any degree of constriction, from partial narrowing up to complete obliteration of the canal. Among the causes producing them may be mentioned extensive sloughing after parturition, or consequent upon diphtheritic or other severe inflammations, surgical injuries, &c.

IMPERFORATE HYMEN is the malformation which most frequently requires active surgical interference, on account of obstruction to the escape of menstrual discharges. In the normal virgin state, the hymen, a thin fold of mucous membrane, is either crescentic forwards or else diaphragmatic with a central aperture ; but, in the condition under consideration, the vaginal orifice is closed by an imperforate membrane of a dense and often extremely tough structure.

Symptoms.—As a rule, the malformation does not excite attention until the age

of puberty, when the non-appearance of the menses, coupled with the recurrence of successive monthly attacks of pelvic pain and severe constitutional disturbance, usually leads sooner or later to investigation.

Diagnosis.—Inspection reveals a tense bulging membrane filling the orifice of the vagina; and, on rectal examination, the pelvis is found occupied by a firm elastic tumour, which abdominal palpation will usually detect rising to a variable height above the level of the pubes, often bearing upon its summit a small firm body recognisable as the uterus.

Prognosis.—The condition, if unrelieved, almost invariably proves fatal by hæmorrhage or by septic peritonitis, resulting from rupture of a distended uterus or of a blood-sac in a Fallopian tube. Occasionally, however, the obstructing membrane may give way, and allow the escape of the fluid imprisoned in the sac formed by the distended vagina.

Treatment for Retained Menses.—In all cases, two main sources of danger connected with the operation required have to be kept in view. The *first* of these, arising from too rapid collapse of the distended sac, is due to the risk thereby entailed of rupture of the Fallopian tubes or of vascular adhesions connecting them with the pelvic walls. This accident, liable to prove fatal by septic peritonitis or by hæmorrhage, should always be guarded against by avoiding any abdominal pressure upon the sac while its contents are escaping. The *second* source of danger referred to is that of septicæmia following the operation, as the result of decomposition of the discharges, a complication which may be averted by the maintenance of efficient drainage and the use of antiseptics.

Operation for Imperforate Hymen.—The best time to select for its performance is midway between two menstrual periods, as indicated by the recurring catamenial molimina. The patient, after anæsthetisation, should be placed in the usual lithotomy position, and the parts then be thoroughly cleansed with 1–20 carbolic lotion. The protruding membrane is next punctured with a full-sized trocar, previously immersed in carbolised oil, and the fluid, usually of a dark colour and thick tarry consistence, must be allowed to escape slowly. On its ceasing to flow, the canula is withdrawn, and the opening freely enlarged by a cruciform incision made with a blunt-pointed bistoury. The cavity should now be gently washed out with a warm antiseptic solution (carbolic acid or corrosive sublimate); and, if thought desirable, a short, full-sized, glass or vulcanite drainage-tube may be inserted. Finally, a thick pad of some absorbent antiseptic material is applied to the vulva. The patient must be confined to bed for some few days after the operation, during which time the dressing should be changed, and the vagina syringed out, twice or oftener in each twenty-four hours.

Operation for Partial Occlusion of the Vagina.—Having first passed a sound into the previously emptied bladder, the surgeon introduces his left index finger into the rectum in order to ascertain the extent and depth of the occluding tissue, as well as the exact position of the distended sac.

After satisfying himself on these points, he entrusts the sound to an assistant, and, with his finger still in the rectum to act as a guide, makes a horizontal incision between the labia, carefully dissecting through the tissues until the sac is reached. This is then punctured and evacuated, with the same precautions as in the above described operation. The cavity having been carefully washed out, is loosely packed with strips of lint soaked in carbolised oil, or with iodoform gauze, and an antiseptic pad is applied externally. The plugs, which require renewal every six or eight hours during the first few days, may then be replaced by a perforated glass or vulcanite tube, which should be worn more or less continuously for a week or two, in order to avoid contraction and closure of the newly-made orifice.

The malformation known as *septate vagina* may require surgical interference for relief of menstrual accumulation, in connection with one or other horn of a bifid uterus. The treatment of such a condition (termed *hæmato-kolpos*) would resemble that above described.

The operation for *complete absence* of the vagina, independently of any menstrual retention, is justifiable only in cases where it is possible by combined exploration of the rectum, the bladder, and through the abdominal wall, to ascertain clearly the existence of a well-developed uterus and ovaries. The procedure required is a much more difficult one than any of the above, owing to the fact that the surgeon will possess no other guide to his incision than the position of the cervix; in all other respects the operative details are the same as in the cases of partial occlusion of the canal.

Partial septa, either congenital or acquired, occasionally necessitate interference. They are best divided by means of the thermo-cautery, care being taken to avoid injury to the vaginal wall.

II. Surgical Injuries.—1. *Wounds* of the vagina always result from direct violence, accidental or intentional. Their immediate gravity in any case depends upon whether or not the peritoneum has escaped injury.

Their *causes* may be various, including falls upon upright pointed objects; violence inflicted by thrusting foreign bodies into the canal; the passage of instruments for purposes of abortion; or the unskilful use of the same during labour.

Superficial wounds of the vaginal wall, not involving the peritoneum, usually give rise to very free hæmorrhage, which may require for its arrest the introduction of a firm plug of some antiseptic material. If extensive laceration have occurred, points of suture may with advantage be inserted as required. Rest in bed and the frequent use of antiseptic injections will readily promote healing. Any subsequent tendency to faulty cicatricial contraction must be combated by the occasional introduction of a full-sized cylindrical speculum.

Wounds *involving the peritoneum* are necessarily of a far more serious nature. Their infliction always gives rise to more or less serious collapse, often succeeded by symptoms of septic peritonitis, which may rapidly prove fatal.

Treatment.—Small *punctured wounds* are best left alone, nothing being attempted in the way of local management beyond the free application of iodoform powder to the surface of the vagina, followed by the introduction of a plug of iodoform gauze, which should be renewed daily. In cases of *extensive injury* to the peritoneum, it is best, as a rule, not to attempt the introduction of any sutures, but to trust to the readiness with which the serous membrane will unite on mere apposition of its torn surfaces. Should the intestine have prolapsed, it must be carefully cleansed with warm carbolised lotion before being returned to the abdominal cavity. In any case of wound of the peritoneum, the patient should as quickly as possible be brought well under the influence of opium, and be so kept until all risk of peritonitis is over.

2. *Foreign bodies* sometimes require to be removed from the vagina. These may have been wilfully introduced by the patient herself; or may consist of pessaries originally placed there under medical supervision, and subsequently neglected. In either case, their presence in course of time gives rise to pain, irritation, and puriform discharge, and may ultimately lead to ulceration, followed by the formation of a fistula. Removal of a foreign body must be effected with care, in order to avoid laceration of the vaginal wall. If large, it may require to be broken up with strong nippers and then taken away piecemeal.

III. Inflammation of the Mucous Membrane of the vagina (*vaginitis, colpitis*) occurs in the *acute* form either as a simple or as a specific affection.

Causation.—*Simple* vaginitis arises primarily from severe irritation of almost any kind, whether of a chemical or mechanical nature. It may also result secondarily from acrid uterine discharges, from secretions due to carcinomatous affections, from the irritation produced by urine or fæces in cases of vaginal fistulæ, or from that caused by the continued presence in the passage of any foreign bodies, such as tampons, sponges, ill-fitting pessaries, &c.

Specific vaginitis is usually caused by direct gonorrhœal infection; but it may also be found as a concomitant of chancroid affections of the external genitals.

A variety known as *diphtheritic* vaginitis is occasionally met with in badly-nourished unhealthy women during the puerperal state, or again in the course of typhus, smallpox, or scarlet fever.

All forms of acute vaginitis, with the exception of that last mentioned, are exceedingly liable to become *chronic* if long unrelieved. The gonorrhœal variety especially is often of the most intractable type, and is moreover dangerous from its tendency to spread to the uterine cavity.

Symptoms and Diagnosis.—In both the simple and the specific form of vaginitis the prominent subjective symptoms are a sense of heat and aching pain about the part, with great discomfort and tenderness on locomotion. On examination, the vaginal mucous membrane is found reddened, inflamed, and swollen, often granular in appearance, and covered with a profuse cream-coloured or greenish puriform discharge. When due to direct gonorrhœal infection, the disease is usually accompanied in the early stage by more or less acute inflammation of the vulva, and not uncommonly by some amount of urethritis, giving rise to frequent and painful micturition. The differentiation, however, between the simple and gonorrhœal varieties cannot with any certainty be made from the physical signs alone, apart from the history.

Treatment, during the *acute* stage of the disease, consists in the administration of a free mercurial purge, followed by a course of diuretic salines with tincture of hyoscyamus, the patient meanwhile being confined to bed and kept on light diet. The vagina should be well douched every four or five hours with a warm solution of acetate of lead in decoction of poppies, or with a lotion containing half an ounce of borax to the pint of warm water. This may be replaced in time, as the acute symptoms pass off, by the use of a colder solution containing tannin or alum in the proportions of one or two drachms to the pint. A remedy often employed with advantage in the *subacute* stage consists of a solution of nitrate of silver (℈j.–iij. ad ℥j.), which should be freely applied to the entire vaginal surface once in every three days.

Should the affection be seen in the *chronic* stage, the daily use of an astringent injection, followed by the introduction of a vaginal suppository, containing twenty grains of iodoform powder, will constitute the best mode of treatment.

IV. Tumours and Prolapse.—*Fibroid growths* in the substance of, or dependent from, the anterior vaginal wall are extremely rare. Removal by enucleation after incision of the capsule, or, if the growth be polypoid, by division of the pedicle with scissors or the thermo-cautery, may be readily effected.

Cysts, varying in size from that of a small cherry to a bantam's egg, may occasionally be found seated on the anterior vaginal wall, within a short distance of the orifice. As a rule they occur singly, but two or more may be met with. They are thin-walled, and usually contain a clear, glairy fluid; but, in some instances, the contents are of a semi-gelatinous consistence, and dark chocolate in colour. Their mode of origin is doubtful.

Unless of any size, they give rise to no special symptoms. On examination, their recognition is easy from the smooth, elastic, and globular nature of the swelling. If small, the cyst may be removed entire by means of a little careful dissection. Another plan of treatment consists in freely laying open its cavity, and cauterising the lining membrane, which subsequently granulates.

Sacculated dilatation of a portion of the urethral canal gives rise to an oval-shaped swelling, of which the position and reducibility on pressure will reveal the true nature.

Treatment consists in removing an elliptical portion of mucous membrane, with its long axis in the direction of the urethra, and approximating the edges of the incision with sutures.

Prolapse of the vagina may be *partial*, involving chiefly the anterior wall (*cystocele*), or more rarely the posterior wall alone (*rectocele*); or it may be *complete*, when both walls are everted with descent of the uterus—a condition often preceded by, although not essentially dependent upon, perineal rupture. The exciting factor in all cases of prolapse is intra-abdominal pressure, commonly resulting—in patients predisposed thereto—from habitual neglect in obeying the calls to evacuate the bladder or rectum. *Partial* protrusions require the employment of suitable vaginal supports, combined with the use of astringent injections or pessaries, and careful regulation of the patient's habits. *Chronic cases* of more or less irreducible prolapse may demand operative treatment with the object of contracting the vaginal orifice, which can best be effected by the usual operation for ruptured perineum, combined with excision of a portion of the redundant mucous membrane of the posterior vaginal wall.

Other procedures which aim at producing cicatricial contraction, or even closure of the canal, rarely prove of any lasting benefit to the patient.

V. New Growths.—*Malignant disease* occurring primarily in the vagina is extremely rare. When met with, it consists either of a localised, broad-based, papillomatous growth usually seated on the posterior wall, or else of a diffused carcinomatous infiltration, sometimes leading to constriction of the canal. Early infection of the inguinal glands commonly takes place.

Diagnosis and Symptoms.—The *papillomatous* form is most frequently seen in aged women, and is usually painless in the early stage, but later on gives rise to a certain amount of fetid discharge, with occasional hæmorrhages. The *diffused* variety, met with in younger women, is very often found to be secondary to uterine cancer.

Treatment.—The frequent use of a dusting powder composed of equal parts of tannin and iodoform will serve to control hæmorrhage and discharge, in addition to promoting the patient's comfort by diminishing fetor. If operative interference be deemed advisable, the diseased tissues must be excised as freely as possible with the help of the thermo-cautery.

Sarcoma of the vagina has been described as occurring either in a diffuse form or as circumscribed nodules. The affection is one of great rarity. Extirpation of the growths may be attempted.

W. A. Meredith.

VAGINAL FISTULÆ in connection with the urinary apparatus are named, according to their situation, *urethro-vaginal*, *vesico-vaginal*, *vesico-uterine* (where the fistulous tract traverses the anterior lip of the cervix to open into the cervical canal), and *uretero-vaginal* (where direct communication exists between a ureter and the vaginal canal). Of these four varieties, the last two mentioned are very rare, the last extremely so.

In the form known as the *vesico-vaginal*, which is by far the most commonly met with, the fistulous opening may be found at any point of the vesico-vaginal septum, varying in size from a minute slit to a large oval or somewhat quadrangular aperture. The margin, at first irregular, swollen, and ulcerated, subsequently, in the course of cicatrisation, becomes thin and firm. In long-standing cases, where the urine escapes readily, the bladder may in time become permanently contracted, the urethra also partaking of the same change from long disuse.

Causation.—Apart from malignant disease, which is the most common cause of vesical fistula in this situation, the majority of cases result from injuries inflicted during parturition, either by direct laceration, or else indirectly from sloughing due to prolonged pressure in tedious labours. Occasionally, ulceration set up by the presence of a foreign body may act, in a somewhat similar way, as a cause.

Symptoms.—The leading feature in all cases of vesico-vaginal fistula is the incontinence of urine. In puerperal patients this symptom, unless when due to direct laceration, may not ensue for some days or even for a week or two after delivery, its occurrence depending upon the separation of the slough caused by the injury. When once established, the flow will vary in constancy according to the position of the fistula; thus, if the opening be seated high up, the lower portion of the bladder will retain a certain amount of urine, and no overflow may occur so long as the patient is erect, although escape at once takes place if she lies down; on the other hand, if the opening be near the neck of the bladder, incontinence will probably be a more or less constant symptom.

Diagnosis.—The chief difficulty of this may lie in ascertaining the exact seat of the fistulous opening. When of any size, its existence on the anterior wall of the vagina can be readily recognised by digital touch, confirmed, if necessary, by the passage of a sound into the bladder and thence into the vagina. But small fistulæ often require the use of considerable care for their detection, either in consequence of the minute size of the aperture, or from the fact of its being concealed beneath a fold of mucous membrane. Should careful inspection, after thorough exposure with the help of a duck-bill speculum, fail to discover it, resort may be had to the plan of gradually distending the bladder by the injection of milk or of some coloured solution, of which any escape through even the smallest opening in the anterior vaginal wall would be readily detected. If no evidence of leakage be seen, a careful examination of the cervix uteri should be made to discover the existence of a fistulous tract.

Treatment.—Small fistulæ, when recent, will often close naturally, provided that rigid cleanliness be observed, and the bladder be kept relieved by the use of the catheter. Even when of some size and standing, their closure may occasionally be effected by cauterisation, but, as a rule, operative measures are required. These are most likely to succeed when undertaken within two to three months after the occurrence of the injury, by which time the tissues will have acquired sufficient soundness without being too firmly cicatrised. In all cases, before anything be attempted, the patient's general health must be attended to, while the parts involved should be brought into as healthy a state as possible.

Three main points require to be observed in the performance of the operation.

1. *The fistulous opening should be completely exposed, in order that its position and extent may be kept well in view throughout the procedure.* For this purpose it is well to have the patient anæsthetised, although as a rule the operation is not a painful one. The first essential is a good light, in front of which the patient should lie in the usual lithotomy position, but with the hips raised to a somewhat higher level than the shoulders, while the thighs are forcibly flexed upon the abdomen. If preferred, she may be placed in the lateral or semi-prone position. The vagina having been well cleansed, a full-sized duck-bill speculum is introduced and maintained firmly in position, so as to retract the perineum and posterior vaginal wall, and allow

free exposure of the vesico-vaginal septum. A sound in the bladder will serve to depress the anterior vaginal wall, thus bringing the fistula within more easy reach; or the same object may be attained by drawing down the cervix uteri by means of a vulsellum or a thread.

2. *The margins of the fistula should be thoroughly pared, so as to obtain a continuous raw surface.* In doing this, the operator, with the help of a tenaculum or fine-toothed forceps, first seizes and puts on the stretch some portion of the marginal mucous membrane. This is next transfixed with the knife in such a way as to split the vaginal layer through the edge of the fistula, and the knife is then carried laterally right and left, so as, if possible, to remove a complete circle of mucous membrane of the desired extent, leaving a continuous border of denuded surface around the opening on its vaginal aspect. If much cicatricial tissue be present, the margin must be more freely pared, even to the extent of removing a rim of vesical mucous membrane; but as a rule this latter should be avoided, in order to prevent risk of after-hæmorrhage into the bladder. The edges having been thoroughly denuded in the way described, or, if preferred, by means of scissors in place of the knife, all oozing must be arrested by the use of ice or of the hot douche.

3. *The sutures are to be introduced, and the freshly pared surfaces brought into accurate apposition so as to completely close the opening.* The best and most manageable material for the sutures is stout silkworm gut, but silver wire is also much used. They may be introduced by small curved needles fixed in a needle-holder; or, if preferred, by means of a handled needle, which is to be threaded after its passage and before being withdrawn. In any case, the needle should be entered about one-third of an inch from the edge of the abraded surface, and be made to transfix both margins of the opening in close proximity to, but without actually piercing, the vesical mucous membrane. When the tissues are dense, its passage may be facilitated by using a blunt hook to afford counter-pressure at the point of exit. The sutures are to be placed at intervals not exceeding a quarter of an inch, care being taken to introduce them evenly, so as to prevent subsequent puckering of the edges. After a sufficient number have been passed and all bleeding has ceased, the raw surfaces are carefully dried with a sponge, and brought into apposition by traction on the sutures, which are then firmly tied, their ends being left long and looped together to facilitate subsequent removal. If silver sutures have been employed, they may be either tied or twisted; or, if preferred, the ends may be passed through a Bozemann's plate and clamped with split shot.

After-treatment.—The bladder should be kept empty by means of a self-retaining vulcanite catheter with tubing attached, or else the urine may be drawn off at frequent intervals by the nurse. Some operators, however, allow the patient to empty the bladder naturally from the first. During convalescence, the vagina must be well douched twice daily with some antiseptic solution. The bowels, as a rule, are to be kept quiet by means of opium for a week or ten days, after which they may be relieved by the use of oil and gruel enemata. The sutures usually require removal on the sixth or seventh day, but, if not causing irritation, they may with advantage be left for a few days longer.

The *less common forms* of vesical fistulæ will require operative treatment varying according to their seat and extent. Thus, for the closure of an opening *in close proximity* to the cervix uteri, it may be necessary to make use of the anterior lip; or if this have been extensively destroyed, the posterior one may have to be brought into requisition by an operation involving obliteration of the os uteri, and thus leaving the uterine cavity to open into the bladder.

In the case of a sinus traversing the cervix (*vesico-uterine*), the anterior lip should be split through in order to fully expose the fistulous tract, which must be freely denuded before re-approximating the opposed surfaces by means of deep sutures.

When *direct* closure of a fistula is impossible owing to very extensive loss of tissue, an operation termed 'kolpokleisis,' consisting in transverse obliteration of the vagina *below* the seat of the opening into the bladder, may be deemed justifiable as the only means of relieving the patient. This object is effected by the removal of a complete ring of mucous membrane from the vaginal wall, and the subsequent coaptation of the denuded surfaces by the help of sutures, until firm union has taken place.

Recto-vaginal Fistula commonly arises from carcinomatous or syphilitic disease of the rectum, in neither of which cases would it be amenable to operative treatment. It may occasionally, however, result from sloughing, consequent upon injuries of the same nature as those which lead to vesical fistulæ. The symptoms com-

plained of are due to the passage of flatus and fæces *per vaginam*.

Treatment consists in paring the edges and closing the opening with sutures, which must not include the rectal mucous membrane. The bowels should afterwards be cleared rather earlier than in the case of a vesical operation, in order to obviate danger arising from scybala. W. A. Meredith.

VAGINAL HERNIA. — In this variety the rupture projects into the vagina. It usually protrudes through the lateral wall of the vagina behind the broad ligament. It may be found in front of the broad ligament, or deep down in the recto-vaginal pouch. The rupture is most often seen in multiparæ. The contents are usually small intestine. In at least one instance a loop of the sigmoid flexure is said to have been involved. So far as reported cases go, it does not appear to have been the subject of strangulation. The tumour may form a serious obstacle in labour.

Frederick Treves.

VAGINAL LITHOTOMY. *See* Lithotomy; Stone in the Female Bladder.

VAGINISMUS is a term applied to a condition occasionally met with in married women of a nervous, irritable temperament, arising from the presence of some persistent local source of irritation about the vulva or the orifice of the vagina. Among such may be mentioned:—Vascular growth of the meatus; fissures of the fourchette or nymphæ; irritable carunculæ myrtiformes; an inflamed or only partially ruptured hymen, &c.

The chief *symptom* of the disease is intense pain and spasm of the parts, induced by any attempt at coition.

Diagnosis must be made by inspection, a careful search being instituted for the discovery of any one of the above-named sources of irritation. Should no local cause be found, the possibility of the symptoms depending upon some internal condition, such as a tender prolapsed ovary, or upon the existence of perimetritic trouble, must be considered.

Treatment will consist in the removal of any local source of irritation.

Vascular growth of the meatus should be destroyed with the help of the thermo-cautery.

Fissures of the fourchette, or around the vaginal orifice, are best treated by division with a sharp knife, or by the application of the cautery, followed in either case by the use of an ointment containing iodoform.

The condition known as *irritable carunculæ myrtiformes* is recognised by the presence of extremely sensitive, nodular projections on the surface of the mucous membrane immediately within the orifice of the vagina; these consist of the remains of the ruptured hymen. In order to obtain a cure in such cases, it is necessary to remove a complete ring of tissue, including the growths in question. This should be effected, with the help of sharp curved scissors, while the patient is under an anæsthetic. The vaginal orifice must next be freely dilated, and then firmly plugged with a roll of iodoform gauze, over which a pad of the same material is to be applied and kept in place by a T-bandage. The use of a self-retaining catheter, with rubber tubing attached, will prevent soiling of the dressings. The plug which, in addition to acting as an efficient dilator, is also a perfect antiseptic, may be left undisturbed for five or six days, when, on its removal, the raw surface will be found healed. The subsequent daily employment, for a few hours, of a glass or vulcanite dilator will prove useful in completing the cure.

A somewhat similar treatment may be followed in cases of an *abnormally tough* or only *partially ruptured hymen*, in newly-married women. W. A. Meredith.

VARICOCELE.—This term was formerly used to denote a varicose condition of the superficial veins of the scrotum, and Circocele was the name given to varix of the veins of the spermatic cord. Circocele has become obsolete, and varicocele is always used at the present time to denote a dilated varicose condition of the spermatic plexus of veins.

Causes.—The disease is most frequently seen between the periods of puberty and full manhood. Cases are occasionally observed in young boys and just before puberty, and the writer has operated upon a man fifty-four years of age, who attributed the development of the varix, and apparently with reason, to a blow received seven months previously. The disease is therefore, probably, in some way associated with the great developmental changes occurring in the testicle at puberty, and the functional excitement of the parts during the years of early manhood. Frequent masturbation, or a lascivious habit of mind, by keeping up a more or less constant congestion of the part, may favour the

development of varicocele; on the other hand, the regular sexual relations of marriage are of use in curing the disease when slight. The more definite local causes of varicocele are the great length and vertical direction of the slender spermatic veins, their plexiform arrangement in the scrotum, with their termination in one, or at the most two, small veins in the abdomen; the imperfect support afforded to the veins by the loose tissues of the scrotum; the great vascular changes attending sexual excitement; injury; and acute inflammation of the epididymis and cord. Occupations involving continuous standing or slow walking, or attended with frequent concussions of the parts, and hot climates are believed to predispose to the venous dilatation, while there is evidence to show that general debility, with a feeble state of the circulation, and a relaxed flabby condition of the tissues, leading to a pendulous condition of the scrotum, is of etiological importance. In a large proportion of cases, the subjects of varicocele are healthy, well-nourished, and well-developed men, in whom it is impossible to detect any cause of increased intravenous pressure, or of deficient external support. In such cases, the writer has suggested that the disease is to be regarded as a true venous hypertrophy, arising during the active changes occurring in the associated organs at and after puberty.

The much greater frequency of varicocele on the left side than the right has been accounted for by the greater length of the left vein, by the fact that the left spermatic vein enters the renal vein at right angles, while the right opens into the vena cava parallel to its current, and by the passage of the left vein under the sigmoid flexure, which, when loaded with fæces, may compress and obstruct it. It must be confessed, however, that, with the exception of the greater length of the left vein, no valid reason for the undoubted fact has been as yet adduced, and even this does not appear to be sufficient to account for the remarkable preponderance of left-sided varicocele. The occurrence of varicocele has also been attributed to the absence of valves in the left spermatic veins; in addition, however, to several valves in different parts of these veins, a single valve, or a pair, are found at, or within a very short distance of, the outlet of the vein on each side; it is easy to demonstrate the competency of these valves, and the impossibility of injecting fluid from the renal vein or vena cava into the spermatic vein.

Pathology.— The affected veins are dilated, pouched, elongated, and tortuous; their walls are thickened with an overgrowth of fibrous and muscular tissue, to such an extent that when cut across they stand open like arteries. Probably all the veins of the spermatic cord are never affected, and the degree to which the dilatation progresses in different veins, and in different cases, varies much. The venous dilatation has been shown to extend to the vessels of the mediastinum testis, and to those lying beneath the tunica albuginea. Localised thrombosis, with the subsequent formation of a phlebolith, may occur. The most important pathological question arises in connection with the testicle. That organ is most often found of its natural size and plumpness, and apparently unaffected by the presence of the varix. In some cases the testicle is a little smaller and softer than its fellow, and in a certain number of cases the testicle is found markedly smaller than its fellow, but of the normal shape and consistence. The explanation of these facts is probably as follows:— If the disease be limited to the cord, as is usually the case, and come on after the testicle has reached its full development, it exerts no injurious influence upon the structure of that organ. But when the vessels within the testicle are varicose, it may lead to a slight shrinking of the tubular structure. If, however, the varices develop before or at puberty, the usual enlargement of the testicle may not take place, and it may continue in its puerile state. The important fact is, that where the testicle is found much smaller than its fellow, it is an undeveloped organ, and not atrophied. There is no evidence that simple varicocele can produce marked wasting of a healthy testicle. Similarly, it appears probable that a varicocele does not interfere with the due elaboration of semen, or render its subject either impotent or sterile. Mr. Curling cites three cases in which the spermatic fluid was found destitute of spermatozoa; but, as in each of these cases the testicle was distinctly small, it is probable that they were instances of the association of varicocele with failure of development of the testicle.

The superficial scrotal veins may be found varicose, and occasionally there may be varices of the superficial veins of the legs. In the worst cases of varicocele, the scrotum is usually very pendulous.

Symptoms.— There may be no subjective symptoms whatever attendant upon even a very large varicocele; the patient,

in such cases, is at the most only conscious of a greater fulness of the left than of the right side of the scrotum, and it is not uncommon for the surgeon to discover a varicocele of which the patient has been quite unconscious. In the majority of cases the patients complain of a sense of weight in the scrotum, and of a dragging pain, extending up into the groin and round to the loin of the same side; this is exaggerated by standing, by effort or by fatigue, and is relieved by rest in the horizontal position, or by support to the scrotum. The frequent or constant occurrence of this pain exerts a markedly depressing influence upon some minds; it also tends to centre the thoughts of the individual upon his sexual organs, excites groundless fears of impotence or sterility, and if the man be deficient in moral control, he may become a sexual hypochondriac. In some rare cases the pain has been so intense that the patient has been quite disabled, apart altogether from emotional disturbance. The pain may be only felt, or felt most, when the bowels are constipated, and it is greatly exaggerated after sexual intercourse, although at the time relief may be experienced. It is a common belief that varicocele may cause frequent seminal emissions; but careful inquiry has shown this to be groundless.

Diagnosis.—Varicocele is generally present on the left side only, and, if present on the right, the left swelling is the larger of the two. The diagnosis is usually made with the greatest ease. The swelling involves the cord, and in many cases projects behind and even below the testicle, but is limited to the scrotum, not extending up into the groin. It is soft, elastic, opaque, compressible, dull on percussion, with a distinct expansile impulse on coughing, and the irregular tortuous veins give to it the feel of a bag of worms. If the patient lie down, the swelling is reduced by simply raising the scrotum, and without a gurgle, or the sensation of a sudden slip, as in the reduction of a hernia. If now the surgeon place his forefinger lightly over the external abdominal ring, and allow the patient to rise, he will observe the gradual reappearance of the swelling first at the lower part of the scrotum, and without his feeling anything slip past his finger. This sign, and the fact that the swelling is limited to the scrotum, will readily distinguish varicocele from hernia, for which it has been most often mistaken; the impulse on coughing, the knotty feel of the swelling, and its ready reducibility distinguish it at once from the œdema of the cord produced by wearing a truss, or the thickness due to the presence of the sac of a hernia.

Treatment.—The first thing to be done in most of the cases coming under the surgeon's notice, is to assure the patient of the innocuousness of the disease—that it will not induce impotence, sterility, or exhausting seminal emissions. If the surgeon is successful in quieting the patient's mental distress, it is not uncommon for all physical distress to pass off too. Where, however, pain is complained of, palliative measures should be adopted. The patient should constantly wear a well-fitting suspender, of which the best is probably one that laces up the front; another good one is that which raises the scrotum into the left groin by a strap fastened to a band round the waist. Night and morning the scrotum should be well douched with cold water, to improve the 'tone' of the dartos. The bowels should be carefully regulated, and if the patient be pale, anæmic, and flabby, the perchloride or other preparation of iron should be given, and moderate outdoor exercise should be insisted on. Severe exertion, or sudden strains, are to be forbidden; but it is most essential to avoid leading these patients to consider themselves to be invalids, or unfitted for the active duties of life; the more they can be absorbed in their occupations, and the better their general health is maintained—by whatever means—the less distress will a varicocele occasion. All vicious practices must be absolutely abandoned, too frequent seminal emissions should be controlled by bromide of potassium, in doses of 3ss., given at bed-time. In some cases a well-fitting truss, maintaining gentle compression on the spermatic veins in the inguinal canal, affords more relief than a suspender, and leads to the gradual shrinking of the varix; it is, however, difficult to adjust a truss with just the right amount of force. When the presence of a varicocele debars a youth from one of the Government services, or from any particular occupation; when the subject of it wishes to live in a hot climate; when palliative measures fail to give relief, and the varix is increasing, or has attained a large size; when the testicle on the same side is notably smaller than its fellow; a radical cure of the varicocele should be attempted. It is probably well to operate upon all varicoceles present before puberty; but in no case is the operation to be recommended until palliative means have failed to give relief, and unless the varicocele is a cause of distinct

inconvenience to the patient. The operation should not be undertaken simply for the relief of the mental distress so often associated with this disease.

Many operations for the radical cure have been devised and practised, but only three require notice here :—(1) The simplest procedure is to pass a straight needle, armed with carbolised silk or chromicised catgut, through the scrotum, between the vas deferens and the veins, and then back again between the veins and the skin, so that the dilated vessels are enclosed in a subcutaneous loop. The thread should then be tied tightly, and the ends cut off short and allowed to slip inside the scrotal puncture. Some surgeons prefer to place two such ligatures round the veins, about an inch apart. (2) Excision of the veins. The part is shaved and rendered aseptic by thorough cleansing with turpentine, corrosive sublimate 1–500, or carbolic lotion (5 p.c.) ; a small fold of skin, over the front of the varix, is raised and transfixed; the large veins at once appear, and are to be cleaned, carefully separated from the vas deferens, and any small, undilated veins, ligatured at the upper and lower end of the exposed part with chromic catgut, and the intermediate portion excised. The skin-wound is to be carefully sewn up with a continuous suture, and a small drain placed in the lower end of the wound. The whole operation, and the subsequent dressing, should be conducted aseptically. This operation certainly cures the disease, and if the above-named precautions be taken, is a safe measure ; but the writer has known it to be attended with suppuration, and with extensive hæmorrhage from slipping of a ligature ; he, having performed it a few times, has come to regard it as inferior to the following procedure. (3) Subcutaneous division of the veins with a galvanic écraseur. The vas deferens is to be carefully separated from the veins at the upper part of the scrotum, and the skin pinched in between the two is to be transfixed with a tenotome or some slender knife, and divided parallel with the vas for $\frac{1}{3}$ inch. Through this incision, a needle, armed with a platinum wire, is to be passed, and returned through the same skin-apertures, but between the skin and the veins. The veins are thus secured in a loop of the wire. The ends of the loop are to be affixed to an écraseur, and the current of one cell of a Grove's battery, or of a small bichromate battery, passed through it ; the heated wire quickly severs the veins and securely sears the cut ends. A moderate traction should be kept up on the wire, so as to draw the veins out of the scrotum as much as possible, and in that way the action of the hot wire is limited to the veins ; the wire must be heated to a dull red colour only. The patient must subsequently rest quiet and still in bed, with the scrotum supported and a small pledget of iodoform wool over each skin-wound. The veins will be felt to become filled with clotted blood, which gradually becomes absorbed. As a rule, the patients are kept in bed for a week, and are able to resume active duties in ten to fourteen days ; they should wear a suspender for another month. Having performed this operation about twenty-five times, the writer can strongly recommend it, on account of its ease, safety, painlessness, and the certainty with which a cure is obtained. The radical cure of a varicocele, by any one of these methods, is not attended with danger to the testicle.

A. Pearce Gould.

VARICOSE ANEURISM. *See* Arterio-Venous Aneurism.

VARICOSE VEINS.–A vein is said to be varicose when it is the seat of permanent pathological dilatation. This condition is frequently met with in the spermatic and hæmorrhoidal veins. *See* Varicocele ; Hæmorrhoids. Of other sites the lower limbs are by far the most frequent, although varix is occasionally found in the veins of the arm, of the neck and face, and also in the deep as well as the superficial veins of the trunk.

1. *Causes.* — The commonly accepted view of the etiology of varicose veins is that they are dependent upon increased intravenous pressure, or a deficient resisting power in the vein-walls, or upon these two conditions acting together. The increased intravenous pressure is usually attributed to one or other of three conditions : increased supply of blood to a part, obstruction to the outflow from a vein, and the influence of gravity. The active hyperæmia associated with chronic ulceration and other inflammatory processes, or with prolonged muscular contraction, throws a greater amount of blood into the veins of a part, and increases the pressure of the blood upon the venous walls. The influence of obstruction to the outflow from a vein is shown by the effects of the pressure of the pregnant uterus or other pelvic tumour upon the iliac veins ; in women, the first occurrence of varicosity of the superficial veins of the leg is very often attributed to

pregnancy. A tight garter applied below the knee, and the pressure of a badly adjusted truss, are other examples of slight venous obstructions acting continuously, to which have been attributed the production of varicose veins in the lower extremities.

The column of blood in the arteries of the lower limb supports that in the veins, but the pressure of the blood upon the venous walls is increased by gravity, and is greatest, therefore, at the lower end of the column. When the valves are intact, the effect of gravity is annulled, but when, from injury, atrophy, or the dilatation of a vein, the valves are inefficient, the influence of gravity is fully felt. Deficiency in the tone or power of resistance of the vein-walls may be an inherited or a primary defect in their structure and function; or it may result from injury to the vein, inflammation of the outer coat of the vein, or from absorption of the tissues which usually support the veins externally. Probably, in some cases, varices are dependent upon obscure vital rather than upon simple physical causes, and the enlarged veins are to be regarded as hypertrophies or overgrowths of the veins, rather than as the results of the intravenous pressure and the tonic resistance of the venous walls.

Conditions to be specially noticed are heredity, age, sex, and occupation. In many cases there is found distinct evidence of the influence of heredity, varicose veins being seen in two or three generations of a family; where heredity is most marked, the varices generally appear early, and affect the larger superficial veins. Varicose veins most frequently begin to show themselves between the age of twenty and thirty-five, just when the frame is attaining to its full development and displaying its greatest activity. Varices are not infrequently met with earlier or later than this age; on the other hand, some cases improve after middle life. The disease is said to be more common in men than women; with the exception of pregnancy and the pressure of pelvic tumours, men are more exposed to the above-mentioned causes of varix, and to this the somewhat greater prevalence of the disease in them than in women is probably due. Any occupation which entails prolonged standing, such as that of a policeman, omnibus conductor, or of a washerwoman, both by the influence of gravity, and also by the powerful muscular contractions necessary to support the body in the erect position, is liable to cause varix. Any occupation entailing constant contractions of the muscles of the lower limbs may have the same effect. A narrowing of the saphenous opening or of other apertures by which the superficial veins communicate with the deep veins has been alleged as a cause of varix, and a plan of treatment has been based upon this assumption. This view has, however, been entirely abandoned, especially since it has been shown that the venous dilatation affects the intermuscular and intramuscular veins as well as the subcutaneous vessels, and probably spreads from the former to the latter, while the superficial veins are specially prone to be dilated at the points where the deeper intermuscular veins communicate with them. A sudden severe strain, causing great distension of a vein, with or without rupture of a valve, may be the starting-point of a varix.

The effect of pregnancy upon the circulation in the lower limbs of women varies much. In many cases there is no interference whatever; in some cases there is some œdema of the feet and ankles in the later stages, without any apparent distension of the veins of the limbs; but in other cases the veins of one or other lower limb, or of both, or of the vulva, are considerably distended. This distension may come on quite early in the course of the pregnancy, before the uterine enlargement can be sufficient to account for it, and in these cases the varicose condition may not become worse in the later months of pregnancy. In other cases, the veins swell out only when the uterus has attained some considerable size, and may be supposed to exert considerable pressure upon the iliac veins. Not infrequently a woman will pass through her first pregnancy without any apparent distension of the veins of the legs, and yet suffer from it in subsequent pregnancies. The venous distension from pregnancy, when once it has occurred, is always repeated with any successive pregnancy; it may or may not persist in the intervals. Varicose veins may be met with in the healthy and robust, but are more common in persons with pale skin, flabby muscles and fibrous tissues, and of lymphatic temperament. The greater frequency of varix in the left than the right leg has been attributed to the pressure of a loaded sigmoid flexure upon the left iliac vein.

2. *Pathology.*—The disease is by no means limited to the superficial veins. It is very rare in the main deep veins of the limbs, except the posterior tibial, but it is common in the intermuscular and intramuscular veins of the lower limbs, and may

attack them before the subcutaneous vessels are dilated. The distribution of the affection in the subcutaneous veins also varies very much. In some cases, the whole length of the internal or external saphenous vein is enlarged, no other vessels being obviously affected; at other times, these large veins are dilated at a few isolated spots only; again, these trunks may be quite unaffected, and certain of their tributaries dilated to a size far in excess of the vessels into which they pour their blood. The small venules of the skin may be distended, or be quite normal; in many cases all these varieties of the disease are met with together. The superficial veins appear to be specially prone to varix just where the deep veins communicate with them, as if the vessel-walls yielded before the force of the double current of blood flowing into them. Varicose veins may be simply dilated transversely; more often they are elongated as well, and thrown into sinuous curves and coils, while, in the worst cases, the vein loses its cylindrical shape, and its walls are pouched out into aneurism-like dilatations.

Changes are usually met with in all the coats of a varicose vein: the inner coat is thickened, and, on slitting up the vessel, is seen to be thrown into longitudinal wrinkles; sometimes it is irregularly thickened (atheroma); or again it may be found to have undergone fatty degeneration and to have lost its transparency. The middle coat is commonly hypertrophied, the muscular tissue as well as the fibrous being in excess, but it may be thinned or absent altogether, especially over the saccular dilatations of a vein. The outer coat is less markedly thickened. Altogether, the venous walls are so notably thickened that, on section, the vein remains open like an artery. The valves are in places absent altogether, or they are found as delicate cords, sometimes adherent to the vein by one extremity only. The coils of a tortuous vein are united by firm fibrous bands, and similar bands unite the vessel to the overlying skin. The skin and subcutaneous fascia over a varix may be thickened, but more often they are gradually thinned; where a large varix lies over a bone, it may be hollowed out into a groove for the vessel. Thrombosis is liable to occur, and lead to the obliteration of the vein or the formation of a phlebolith. A more serious complication is a gradual thinning of the vein and of the skin over it, until it bursts.

3. *Symptoms and Diagnosis.*—An extreme degree of varix may be met with without giving rise to any symptoms whatever. The worst case ever seen by the writer was in the leg of a man eighty years of age, in whom the whole length and circumference of the limb had been covered with very large tortuous veins for about sixty years; during the whole of this period there had been no pain or œdema, nor any symptom to trouble the patient. More often, varices are the seat of a dull aching pain or a sense of weight and fulness in the part, when from prolonged standing or walking, or any other condition, they become fully distended. Occasionally, when a vein presses upon a nerve, the pain is more acute, and is referred to the extremity of the nerve. The pain is quickly relieved by raising the part and lessening the fulness of the veins. Varix of a deep vein has been thought to explain the occurrence of cramp-like pains in a part. Varicose veins are often associated with simple œdema, chronic induration of the skin and subcutaneous tissue, eczema and chronic ulcers; but how far these conditions are directly dependent upon the dilated veins is open to question.

The *diagnosis* of superficial varix is quite easy: the enlarged vein is recognised by its tortuous cylindrical outline, its compressibility, the readiness with which it fills out again into a soft swelling when pressure is removed, and by its continuity with normal veins. When the varix is large and near the trunk, there may be a distinct expansile impulse on coughing. When the coverings are thin, the blue colour of the vein may be distinctly seen. This is especially the case when a venous pouch is about to burst. The varices vary greatly in size, extent, and distribution; they may be found at intervals along either saphena vein, or forming a close network of veins below either malleolus. A varix is often found crossing the front of the leg above the middle, or running over the front of the patella, or in the lower third of the front of the thigh. Varices of the small cutaneous veins appear as fine blue lines in the skin, generally grouped in a stellate manner. Rupture of a varicose vein may occur spontaneously or during some straining effort; the bleeding is rapid, blood flowing from each end of the vein. This accident generally happens to branches of the main veins, and particularly in the lower third of the leg; it may occur in the vulva. Deep varix may be diagnosed when the patient has dull or cramp-like pains in the leg on standing, which are at once relieved by lying down or raising the limb.

4. *Treatment* may be spoken of as palliative or curative, of which the former is the more generally applicable. Where varix has developed acutely after some sudden strain or prolonged exertion, the patient should rest in bed or on a couch for a month or six weeks, with the part evenly bandaged, and during this time the diet should be unstimulating and the action of the bowels carefully regulated. Subsequently, he should carry out the usual palliative treatment, which consists in affording external support to the veins and in preventing their undue distension. The external support may be afforded by well-fitting elastic stockings or by a carefully applied bandage. The stocking should not be too tight or too strong, and should fit the leg evenly; the bandage may be of cotton, thin flannel, or thin perforated pure rubber, and, when well applied, is often more comfortable than an elastic stocking. When any one vein is specially enlarged, it is a good plan to place a pad of corresponding size over it under the stocking or bandage. Where the venous enlargement is only slight, it is often sufficient for the patient to wear well-fitting silk or angola stockings, putting on a fresh pair each morning. Garters should not be worn at all, or only fastened round the thigh.

Venous engorgement should be prevented by avoiding prolonged standing, sudden straining efforts, or fatiguing exercises, these rules being enforced with a stringency in direct proportion to the acuteness of the disease, its tendency to increase and affect additional veins, and the distress it occasions to the patient. In the great majority of cases, walking and the various athletic exercises may be practised with advantage to a point short of fatigue or pain, especially if afterwards the leg be raised to a level with the hips. Applying to the part, after the cuticle has been removed by a blister, the solution of perchloride of iron, or the external use of the tincture of witch-hazel has been recommended, but the writer is unable to advocate either measure from his personal experience. Constipation is to be carefully avoided. Where the patient is anæmic, the astringent preparations of iron should be administered internally.

When varicose veins arise during pregnancy, the patient should wear a bandage on the legs, and rest as much as possible in the horizontal position, and, after her confinement, she should still continue to wear the bandage for some weeks.

When a vein is threatening to burst, the part should be carefully bandaged and kept horizontal. When a varix has ruptured externally, the bleeding may be easily controlled by raising the limb; a pad of lint should then be firmly bandaged over the wound, and the leg kept at rest for a week until the scar is sound.

Many modes of obtaining the radical cure of varicose veins have been suggested and practised, only some of which need be mentioned.

1. *Acupressure.*—A flat needle, preferably with a curved point, should be passed beneath the vein, and a piece of quill or gum bougie be laid over the vein, and held firmly in place by silk twisted over the ends of the needle in a figure of eight. Two pins may be placed near together, and the vein divided subcutaneously between them. If, on introducing the needle, venous blood escape, its point should be withdrawn and passed in deeper at a closely adjacent spot. The pins should be withdrawn in about a week, but this time may be shortened or lengthened if the reaction in the part is excessive or too slight. The pins must not be passed where the skin is inflamed. This method often fails to obliterate the veins.

2. *Ligature.*—An incision just long enough to expose the vein is made through the skin and cellular tissue, and through it, by means of an aneurism needle, carbolised silk or chromic acid catgut is passed around the vein and tied. The ligature is generally applied in several places; it may be used as a double ligature, and the vein be divided between. It obliterates the vein safely and certainly; the extent of the vessel obliterated at each ligature is usually only small.

3. *Excision.*—An incision is made over some length of a varix, and carried down so as to expose the vein. A double ligature is then tied around one end of the vessel, and the latter is divided between and raised from its bed; each branch entering the varix and its lower end are similarly divided between double ligatures, and the edges of the skin-wound are united by sutures. This operation is more formidable than the others, but completely removes the disease.

The external application of caustics or the intravenous injection of coagulants is not to be recommended.

In view of the implication of the deep veins in varicose disease, the radical cure of superficial varices is not generally advisable, and when practised is often disappointing. The cases most suitable for it are those in which there are only one or two veins affected, or in which some one or two varices are the cause of special in-

convenience or suffering. Where a patient is disabled by the disease, and this is limited to one or a few parts only, the radical cure should be attempted, and the younger and more healthy in other respects the patient, the greater the desirability of the operation. As a rule, to which there are few exceptions, chronic œdema or induration or ulceration of the skin and subcutaneous tissues is a bar to operation; but where a varix can be traced down to an ulcer, obliteration of the vein is sometimes the best means of curing the ulcer. Where the varix to be treated consists of an isolated 'bunch of veins,' excision is the best operation. Where it is desired to obtain the obliteration of a number of varices or of several parts of one long dilated vein, the application of the ligature or of acupressure is the best means to adopt, and of these the ligature is preferable. Ligature and excision should be performed with careful antiseptic precautions. The dangers of spreading phlebitis and of embolism must be kept in view in the after-treatment. A. Pearce Gould.

VARIX OF LYMPHATICS. *See* Lymphangiectasis.

VEGETATIONS, Adenoid. *See* Naso-Pharyngeal Growths.

VEGETATIONS, Syphilitic. *See* Syphilis.

VEINS, Air in. *See* Air in Veins.

VEINS, Diseases of. *See* Phlebitis; Thrombosis.

VENESECTION, the operation of opening a vein for the purpose of general blood-letting. One of the vessels at the bend of the elbow is commonly chosen, but if these should be too small or from any reason unsuitable, the external jugular vein at the root of the neck or the internal saphena above the ankle may be utilised.

Apparatus required.—Lancet or small double-edged scalpel, bandage, tape, pad of lint, bleeding basin, sponge and water.

Operation.—I. *At bend of Elbow.*—The patient being in the recumbent or sitting position, with the limb extended and supinated, a piece of tape should be tied around the upper arm at about its middle, sufficiently tightly to obstruct the venous circulation without interfering with the pulse. The veins having become swollen, the median cephalic or median basilic, whichever happens to be the larger, is selected; if they are of equal size the median cephalic is preferable, in consequence of the extreme proximity of the median basilic to the brachial artery.

The elbow having been grasped in the operator's left hand, the vein is fixed by placing the thumb on it just below the site of the proposed opening. The lancet-blade, held between the finger and thumb of the right hand, is then passed into the vessel until the blood flows by its side, the blade is carried onwards, horizontally, for about one-third of an inch and made to cut its way out so that the wound in the skin shall be larger than that in the vein. The pressure of the thumb is then removed, and the blood allowed to flow into the bleeding-bowl until the required amount has been taken. If the stream be sluggish, the patient should hold a stick or rolled bandage in the hand, and grasp it firmly at frequent intervals.

To arrest the bleeding, the constriction around the arm must be removed, a pad placed on the wound and retained in position by a figure-of-eight bandage or tape. For two or three days the arm should be carried in a sling; at the end of the fourth day, by which time the wound has, as a rule, healed, the pad and bandage may be dispensed with.

In opening the vein, it is of the utmost importance to avoid cutting too deeply, otherwise the posterior wall of the vessel may be laid open, a mishap which sometimes proves serious in the case of the median basilic vein, when the brachial artery is likely to be wounded and a varicose aneurism or aneurismal varix to follow. Care must also be taken to prevent the skin from gliding over the opening in the vein and so forming a valve-like wound, which is apt to impede the flow of blood and lead to subcutaneous extravasation.

II. *At root of Neck, Venesection of External Jugular.*—The patient being, if possible, in the reclining position with a pillow under the shoulders, and the head turned to the side opposite that selected for the operation, a small cork or hard pad of lint should be placed on the vein, as it dips under the clavicle at the outer border of the sterno-mastoid muscle, and held firmly in position by the thumb, or, more conveniently, by a bandage passing beneath the opposite axilla. The vein should then be opened in the manner already described, as it lies on the surface of the sterno-mastoid, the incision being made in the direction of the fibres of that muscle—i.e. transversely to the fibres of the platysma. The blood may be caught in a shallow receiver, or conducted into a bleeding-basin by means

of a small funnel or a channel made of paper or cardboard.

To arrest the bleeding, a compress should be placed on the wound and held in position by the thumb until the pad above the clavicle has been removed, when it may be firmly strapped in its place. Much care is necessary in the adjustment of the clavicular pad, as its great object, in addition to obstructing the circulation, is to obviate the possibility of air passing down the vein, which is the main risk in this operation; for the same reason it should on no account be disturbed until the opening in the vein has been closed.

III. *Above Ankle.—Venesection of Internal Saphena.*—A method rarely practised in this country. A tape having been tied around the leg just below the calf to obstruct the circulation in the vein, the operation is performed in the same way, step by step, as that described at the bend of the elbow. To increase the flow, should it be sluggish, the foot may be continually rubbed in an upward direction or held in warm water. WILLIAM H. BENNETT.

VENOMOUS SERPENTS, Bites of.—The poison is secreted by a gland situated behind the eye and beneath the masseter muscle; thence the fluid is conveyed through a curved duct to the base of the fang, and by a channel traversing this tooth, or by a groove in its posterior surface, the secretion is discharged. The upper fangs alone admitting the venom, it is important always to estimate in any case the size, position, and number of the punctures.

Poisonous serpents abound in India, America, Africa, and Australia, and in England there is one—the adder. The best known are the Indian cobra, the American rattlesnake, and the Australian tiger, black, brown, and copperhead snakes. The general effect of the poisons of all these is very similar, and it is probable that the essential lethal element is the same, while certain peculiarities give different local effects.

The Venom.–The secretion of the poison-glands seems to be in all venomous reptiles essentially the same in appearance. Thus, Prince Bonaparte described that of the viper as 'having a gummy appearance, somewhat resembling uncoloured varnish, perfectly clear and transparent;' while Halford says of the venom of the black snake of Australia that it is a 'faintly yellowish pellucid fluid, ranging in consistence from thin syrup to thick gum-water, and upon exposure rapidly thickens, and becomes like hard gum.' Fayrer describes the cobra-venom as a 'clear, slightly viscid fluid, soluble in water, and slightly acid.' It will keep months or years between slips of glass and still retain its virulence, and even after the heads have been long in spirit the poison retains its power.

The effects of the venom are the same in all the most deadly snakes. There seems no limit to the amount that may be taken harmlessly into the stomach, nor does it matter whether the animal be fasting or not. This explains the freedom from poisoning after sucking a wound; but here it must be pointed out that, as the poison may be absorbed through an abrasion, great care is necessary. While the mucous membrane denies a passage to the poison, the synovial membranes allow it to pass rapidly into the system. It is stated by Fayrer that the flesh of animals killed by the venom is not poisonous, and is eaten by the natives. The coagulating power of the blood seems to be destroyed in nearly all cases, and this is shown, not only by its fluid condition after death, but by the free bleeding from the wound, the ecchymosis, the hæmoptysis, and the escape of blood in the stools.

Mitchell observed that when rattlesnake poison was applied directly to the mesentery, rupture of the small vessels occurred, an effect going far to explain the hæmorrhages. Extravasations are found in the serous membranes. Rigor mortis is said always to be present.

Symptoms.—In England, the bite of the adder sometimes gives rise to serious symptoms. Several cases are recorded in the journals from which, and from a case seen by the writer, this account is drawn. Locally, pain is immediately felt—acute and burning—and is rapidly succeeded by swelling. The punctures are very fine and appear as two discoloured points. In one class of cases the part swells rapidly, the skin retaining its natural hue. The swelling extends up the forearm and arm, over the shoulder, down the side of the chest, over the back, and may reach the abdomen and groin, and with all this there may be no discoloration, no pain, no glandular enlargement, and few, if any, constitutional symptoms after the first few hours. Gradually the swelling subsides, leaving the arm unaffected. This form of swelling is peculiar, and does not correspond with any of the common affections, and seems special to this poison. In other cases, however, lividity and ecchymoses accompany the swelling, or even a diffuse cellular inflam-

mation may occur, as in a case recorded by Mr. O. Pemberton.

The general symptoms appear quickly, faintness, sickness, and diarrhœa being the earliest and most constant. The pulse is quick, feeble, and may become imperceptible. Dyspnœa also is common. Some complain of intense epigastric pain, and in one case mucus and blood appeared in the stools. The removal of a ligature in one case produced sudden fainting, and it was a week before the patient recovered. Again, in others there may be few or no general symptoms.

Weir Mitchell says that the bite of the rattlesnake is sometimes followed by pain of a pricking or burning character, which gradually becomes intense. Blood flows freely from the punctures, and the parts around swell and become discoloured from extravasation of blood. The wounded extremity becomes larger and the pain greater, the skin assuming a mottled, marbled aspect. A phlegmonous inflammation follows in some cases as a secondary effect, associated with glandular enlargement, suppuration and even gangrene, great depression of the nervous system and general prostration with profuse sweats, vomiting, dyspnœa and diarrhœa. Five and a half hours he gives as the shortest period in which death occurred.

After the cobra-bite death may occur very quickly, with prostration and other symptoms like rattlesnake-poisoning. Fayrer gives one case in which death occurred in half an hour; others lasted two, ten, and twenty-four hours, and one as long as eight days.

Halford says of the bites of the snakes of Victoria that the commonest effects are vomiting, dilated pupils, feeble and intermittent pulse, followed by lethargy and coma. In other cases consciousness is very slightly or not at all impaired, and there are muscular spasms, chiefly of the neck, and tenesmus. These latter are the more serious.

Treatment.—The leading authorities—Weir Mitchell, Halford, and Fayrer—on snake-poisons agree that the mortality of fang-wounds has been greatly exaggerated, for many are inflicted by non-poisonous serpents, and, as much depends upon the condition of the reptile at the time, a poisonous snake does not always give a fatal bite. It is from neglecting such points as these that so many innocent substances, as olive oil, snake root, ammonia, salt, &c., have obtained an undeserved reputation. No doubt the great drawback to successful treatment is the delay caused, in many instances, by the distance of the victim from efficient help, and, amongst natives, to their preference for the charms and incantations of their medicine-men. There is again the great confusion attending the occurrence, its suddenness, the rapid gliding away of the serpent, the doubt as to whether it was poisonous or not, and the intense mental dread of impending death and the shock consequent thereon. The native methods also of beating the victim with sticks, walking him about, and keeping him awake by loud noises, tend to increase the exhaustion, while, on the other hand, amongst more civilised communities, the custom of administering large quantities of brandy or other spirit, produces a variety of symptoms, in which it is difficult to say how much is due to the remedy and how much to the poison. Therefore it is that all writers with a practical acquaintance advise a more deliberate use of remedies, and a careful estimation beforehand of the amount of venom probably introduced. Whatever the kind of snake, whether Indian, American, or Australian, one treatment is applicable in all cases. The following summary is drawn from the writers named. It must be here remarked that in the case of the English adder, immediate ligature with incision, sucking or cupping, followed by the 'relaying' of the constricting band, is sufficient local treatment.

In all cases, where possible apply a ligature tightly above the wound, and one or two others higher up the limb, at intervals of a few inches. Tighten that nearest the wound by twisting with a stick, as it requires a great deal of pressure to prevent absorption.

Now consider the case; determine if possible whether or not the snake was poisonous, whether a large dose of poison is likely to have been introduced or not; examine the number of fang-wounds. We may by such inquiries be enabled to reassure the patient, and allay the mental dread, or obtain sufficient data for extreme measures.

In all cases freely excise the part, taking away the subcutaneous connective tissue, and apply to the raw surface strong carbolic acid, the cautery, or a mineral acid; or, before this is done, let the wound be sucked by the patient if possible, or by someone not unwilling to incur a slight amount of risk. Instead of this a cupping-glass may be applied.

If the snake be a deadly one, or if the dose of poison be large, amputate at once above the wounded part.

Now await the onset of symptoms, keeping the patient quiet; if they appear, give stimulants gradually to restore the force of the heart. Should the patient recover the first absorption of the poison, loosen the highest ligature and wait for the renewal of the symptoms, and when these appear, reapply the ligature, and administer the stimulants. Repeat this method of 'relaying' the ligature, finally removing it altogether, for the parts beyond are sure to suffer if deprived too long of their blood. The sudden removal of a ligature, in the case of an adder-bite, produced fainting in a lad showing no symptoms up to that time. By admitting the poison which must necessarily enter the circulation in this intermittent way, the patient may be able to survive the effect of small doses. 'There is reason to believe,' says Halford, 'that, if applied without delay, a ligature may stay the course of the poison and life be saved.' Unfortunately, it is neither applied quickly nor tightly enough, owing to the ignorance of those most commonly bitten.

If a ligature cannot be applied, the part must be at once freely excised, and the blood removed by sucking or by a cupping-glass, and then the wound freely cauterised. A live coal is often used for this purpose.

The general symptoms must be met as before by stimulants, hot bottles, sinapisms and galvanism.

The intravenous injection of ammonia was introduced by Professor Halford in poisoning by Australian snakes, and the cases he records leave no doubt as to the efficiency of the remedy under some circumstances; and when it is remembered that Halford himself states that the venom of the cobra and crotalus (rattlesnake) is identical in action with that of the Australian snakes, it is disappointing to find that a like success has not attended the use of the remedy in the hands of Indian and American physicians. The number of cases in which ammonia has been employed is sufficient to prove that no harm has resulted from its use, and therefore this fear need not deter others. The *liquor ammoniæ fortior* is used, mixed with distilled water. The following proportions are taken from Halford's cases: ten minims to twenty of water restored consciousness; twelve to a drachm of water restored a man whose pulse was feeble and intermittent, and whose pupils were fixed and dilated; fifteen with five of water, and again in the same case twenty minims with five of water were injected twice, while in another case one and a half drachms in all were used.

Permanganate of potash has recently been recommended, but has, with liquor potassæ, been found of no value by the majority of observers, so that at present we have no specific against snake-bite.

CHARTERS JAMES SYMONDS.

VERRUCA. *See* WARTS.

VERTEBRAL ARTERY, Ligature of the.—This artery was first tied by Dr. Smith, of New Orleans, on May 9, 1864, as an adjunct in the surgical treatment of an innominate aneurism. In 1879 and following years the writer performed the operation on thirty-six cases of epilepsy. After the first case he mostly tied both arteries simultaneously. He also performed the same operation on two cases of infantile paralysis, two cases of locomotor ataxy, and one case of chorea.

The operation is best performed in the following manner:—An incision, three to four inches long, is made in an upward and outward direction along the hollow which exists between the scalenus anticus and the sterno-mastoid muscle. The incision should begin just outside and on a level with the point where the external jugular vein dips over the edge of the sterno-mastoid muscle, or if the vein is invisible, about half an inch above the clavicle. The external jugular vein is to be drawn inwards with the sterno-mastoid muscle. The connective tissue now appearing in the wound is opened up by a blunt director until the scalenus anticus muscle, the phrenic nerve, and the transverse cervical artery are seen. It cannot be too well remembered that the pleura is at the inner side of the wound, whilst below lies the subclavian artery. It is now only necessary to separate the edges of the scalenus anticus and the longus colli muscles to see the vertebral artery lying in the space between them. The artery is generally covered completely by its vein, and the latter has to be drawn aside previous to ligature. Some surgeons look for the prominent transverse process of the seventh cervical vertebra, and this is a good landmark.

Should the artery enter the vertebral foramina higher than usual, the vessel must be looked for to the inner side of its usual course. The overlying vein may be drawn outwards or inwards. Generally the first is more convenient, and may be easily managed by means of an aneurism-needle. Another needle is now passed from without inwards behind the artery, its eye threaded with catgut, and the needle

withdrawn, carrying the ligature. The vein is then to be released, and the ligature tied and cut off short in the usual way. The wound is now to be sponged out with boracic or other lotions, a drainage-tube inserted, and dressings—either strictly or modified antiseptic ones—applied. If the operation is performed with suitable retractors and a good light, the proceeding is a very easy one, and without both it is well-nigh impossible. It is also safe, as no important structure need be at all interfered with.

It has been recommended to tie the artery by coming down upon it directly from the surface, but it is better not to describe that method here. It is only a dissecting-room operation, in which interference with the pleura and the subclavian branches and large veins does not signify much, and cannot compare practically with the easy, safe, and natural operation already described.

Value of the operation in Epilepsy.—It was performed by the writer in the hope that a lessened supply of blood to the hinder brain and spinal cord would result in a diminution or cessation of the epileptic convulsions. On most theories of epilepsy the expectation was a very reasonable one; because it was hoped that the diminution would be more permanent to the parts supplied after ligature of the vertebrals than after ligature of other vessels, on account of the absence of anastomosing branches, and the restraints to dilatation of the unligatured vessels by the bony canals through which the cerebral vessels pass, as the experiments of Sir Astley Cooper on dogs tended to prove. For a time these expectations were realised, but soon relapses occurred, and in May 1884 an analysis of thirty-six cases of operation for epilepsy showed only eight cases which have had so few fits since operation that they may be practically considered cures. Eleven were for several months so much improved that they seemed to be cured; and, although the fits have recurred in all, yet the improvement is still distinctly manifest in many. In sixteen cases there did not seem to be any decided improvement, either of a temporary or permanent kind. Three died out of the thirty-six, one from hæmorrhage, one from embolism, and one from pleurisy. All the cases operated on were chronic, hopeless epileptics, many of whom had gradually become mentally affected. None of the latter were permanently benefited to any practical extent. Of the others the best case was an idiot boy, now in the Albert Asylum, Lancaster, and the next best a perfectly sensible, healthy lad. In two cases of traumatic epilepsy, one was cured and the other much benefited. It is impossible, therefore, to say, before operating, what cases would probably derive benefit from the operation and what would not.

On account of this uncertainty, the writer has ceased to recommend or perform the operation for the last two years. Of the cases of infantile paralysis, one patient was completely and rapidly cured, the other was unaffected. Great temporary advantage occurred in one case of locomotor ataxy. The pains and ataxy rapidly diminished for a time; the other case remained unaffected. The case of chorea ceased to twitch, until hæmorrhage from a small vein set in, that, allowed to pass unnoticed, ended in death. The twitching reappeared after the hæmorrhage. As far as the writer can at present see, this chapter of surgery may be closed.

Wm. Alexander.

VESICO-INTESTINAL FISTULA.

A communication between the interior of some part of the intestine and that of the bladder. The congenital form of this condition and those which result from injury or disease of the rectum have been described under Atresia Ani; Injuries and Diseases of the Rectum.

Vesico-intestinal fistula may also result from wounds or malignant disease of the bladder, or from suppurative inflammation of the intestine, bladder, or adjacent structures. Adhesion of the intestine to the bladder, directly or indirectly, is essential for the formation of the fistula. The channel may be short or long, direct or tortuous, narrow or wide. In some cases, it passes obliquely through the walls of the intestine or bladder so as to render the aperture valvular, and thus resembles the connection of the ureters with the bladder. The intestinal aperture may be in the rectum, the sigmoid flexure, the vermiform appendix, the cæcum, or the small intestine. The vesical aperture may be on any surface of the bladder. Of these varieties the recto-vesical form occurs most frequently. In vesico-intestinal fistulæ, of traumatic or malignant origin, the intestinal aperture is almost invariably in the rectum or sigmoid flexure. Of eighteen cases, not of traumatic or malignant origin, collected by Blanquinque, nine opened into the rectum, four into the sigmoid flexure, two into the vermiform appendix, one into the cæcum, and two into the small intestine.

Traumatic vesico-intestinal fistulæ may be caused by gunshot or other penetrating wounds from without, or by perforation of

the bladder or rectum by foreign bodies introduced through the urethra or anus. Non-traumatic fistulæ most frequently result from necrosis of malignant growths involving both rectum and bladder. Fistulæ of suppurative origin may result from typhoid ulceration of the small intestine, typhlitis, perityphlitis, perforation of the vermiform appendix by impacted foreign bodies, or from ulceration caused by simple or syphilitic stricture of the rectum or sigmoid flexure. When the fistula originates in the bladder, chronic cystitis, especially when associated with a sacculated condition of the bladder, appears in some cases to have been the exciting cause. Suppuration or tuberculosis of the prostate gland may result in a recto-vesical fistula. Pelvic abscesses may also open into both intestine and bladder, and so produce a fistulous channel interrupted by the abscess-cavity.

The *symptoms* of vesico-intestinal fistula vary in different cases. Usually, the attention of the patient is first attracted by the passage of gas from the bladder towards the end of micturition with a sound—compared, by those who have had an opportunity of hearing it, to that produced by the passage of the last portion of fluid from a soda-water siphon. If the fistula be narrow, this may be the only symptom, and may only occur occasionally. The intermissions are, probably, due to blocking of one or other aperture of the fistula by inflammatory swelling of the mucous membrane of the bladder or intestine. If the channel be wider, urine may pass into the intestine, or some of the solid contents of the intestine into the bladder. In recto-vesical fistula, the passage of urine by the anus cannot fail to attract the attention of the patient. In other forms the diarrhœa, which would probably result from the irritation of the mucous membrane of the bowel by contact with urine, would mask this symptom. Any solid matter passed from the bladder should be examined microscopically for the undigested residue of animal or vegetable food, and chemical tests for the bile-acids might also be applied. The bladder is in some cases very tolerant of these foreign substances; in other cases they excite severe cystitis, and always endanger the formation of calculi and retention from the possible occlusion of the vesical orifice.

The *diagnosis* of vesico-intestinal fistula is usually not difficult. The passage of gas from the bladder at the end of micturition is almost pathognomonic. In recto-urethral fistula, gas may also pass from the urethra; but this may occur at any time, and not necessarily during micturition. In vesico-intestinal fistula it is always towards the end of micturition. Gas is said to be sometimes generated in the bladder from decomposition, in rare cases of acute cystitis; but in such cases a speedily fatal result would terminate all doubt. The passage of urine by the anus, or of solid intestinal contents by the urethra, could leave no doubt of the nature of the case. Sometimes, the diagnosis is aided by the urine, passed normally from the bladder, being coloured by the drugs employed to check the diarrhœa. There is very great difficulty in localising the intestinal aperture, if this be beyond the reach of digital or ocular examination. The injection of coloured fluids into the bladder or the rectum has been suggested as a possible aid, but in some cases the requisite force might produce dangerous consequences, and in others a valvular aperture to the fistula, or the intervention of an abscess-cavity in its course, might render the experiment fallacious. Careful bi-manual examination of the pelvis and minute inquiry into the previous history might give some indications; but there must always be uncertainty as to the position of the intestinal aperture in non-malignant fistulæ, when the aperture is higher up than the rectum.

The *treatment* must vary with the nature of the case. When the fistula has supervened on malignant disease, lumbar colotomy will, if the condition of the patient allow of the operation, afford great relief by diverting the course of the fæces. In two cases of non-malignant fistula, this operation was performed by Pennell and Holmes with very satisfactory results. This procedure can only be adopted, when there is reasonable probability that the artificial anus will be above the intestinal aperture of the fistula. In one case of non-malignant fistula, where the channel was probably narrow, permanent occlusion was effected by the constant retention of a catheter for six weeks, the bladder being thus kept in a contracted condition. In similar cases, if the catheter should cause irritation, a temporary perineal fistula would probably be of service. If the case be complicated by a vesical calculus, this should be removed by lithotomy or lithotrity; but if the fistula has resulted from chronic cystitis, the condition of the kidneys might contra-indicate any operation. When more active treatment is impossible, careful irrigation of the bladder and attention to cleanliness and diet will give some relief.

JEREMIAH MCCARTHY.

VESICO-VAGINAL FISTULA. *See* Vaginal Fistulæ.

VESICULÆ SEMINALES.—The diseases of the seminal vesicles have received but slight attention, and little is known concerning them. These organs may be the seat of acute, subacute, or chronic inflammation, and the acute form of the disease may run on to suppuration, the abscess bursting into the bladder or the peritoneal cavity. Chronic inflammation may cause obliteration of the common ejaculatory ducts. The vesicles may be dilated into cystic swellings opening into the urethra, or closed cysts attaining a large size may develop in connection with them. Small spermatic concretions, or larger calculi, may form, and lodge in the vesicles. Lastly, they may be the seat of strumous or of cancerous disease. The vesicles can be easily explored from the rectum, and the diagnosis of their affections mainly rests upon the results of a rectal examination.

1. *Inflammation.*—The most common cause of inflammation is gonorrhœa; other causes are venereal excesses, masturbation, caustic urethral injections, and prostatitis. When *acute*, there is general febrile disturbance, severe pain felt in the groin, hip, and round to the loin of the same side, frequent painful micturition, and the finger in the rectum detects a tender firm swelling just beyond the prostate. Should *suppuration* occur, there may be a rigor, the swelling is increased, and fluctuation may be detected in it when suprapubic pressure is made. *Subacute* and *chronic* inflammation are characterised by local pain and tenderness, frequent micturition, frequent painful erections, the presence of spermatozoa in the urine, a gleety discharge, and excessive nocturnal pollutions, the semen being discoloured red or brown; in some cases similar emissions occur during defæcation.

Treatment.—In the acute form, rest in bed, hot hip-baths, a brisk saline purge, slop diet, and opium and belladonna suppositories. As soon as fluctuation can be detected, the abscess should be opened through the rectum. The treatment of chronic inflammation is unsatisfactory; sexual excitement and constipation must be avoided; tonics, such as quinine and iron, may be useful; but a cure can only be hoped for after a period of many weeks or months.

2. *Cysts.*—These rare tumours may cause difficulty in defæcation and frequency of micturition. They displace the bladder upwards and forwards, fill the pelvis, and then rise into the belly. The diagnosis is made by noticing the position of the tumour between the rectum and bladder, by finding, when a catheter is introduced into the bladder, that that viscus is empty and stretched over the front of the swelling, and by detecting fluctuation in the mass. The only appropriate treatment is to tap the tumour, with a trocar and canula, through the rectum. Should this, when repeated, fail to cure the case, it would be right to inject iodine into the cyst, as in the case of a vaginal hydrocele.

3. *Tubercular Disease* of the seminal vesicles is only known as occurring secondarily to tubercular inflammation of the testicles, prostate, or bladder. The pathological changes are similar to those in the testicle. There are no special symptoms distinguishing this affection, and it can only be recognised by detecting the nodular and slightly tender mass of the enlarged vesicle lying between the rectum and bladder behind the prostate. Owing to the frequency of this complication, and the ease with which it can be recognised by rectal examination, it should be sought for in all cases of tubercular disease of the testicle. The only suitable treatment is the constitutional treatment mentioned under *Tubercular Disease of the Testis*. *See* Testis, Diseases of the. Should any part of the infiltrated vesicle fluctuate, it might be opened through the rectum. A. Pearce Gould.

VIBRIO is a small organism, one of the Schizomycetes, the form of which is that of a curved bacillus. The curves may be one to two in number.

Vibrios are found in stagnant water, in the fluids of the mouth, and recently in considerable quantities in the small intestine in cholera.

Vibrio choleræ, also called the 'comma bacillus' (Koch), is an organism which behaves in its mode of growth, in both solid and liquid cultures, just as a putrefactive organism; it liquefies gelatine, forming a deep well in the substance, and when grown in liquids it forms a scum which afterwards sinks.

In form it exhibits various shapes between the simple curved rod and a spiral (?) figure, produced by segmentation without separation of the individual organisms. Experimental inoculation on the lower animals has, so far, been productive of results of only doubtful value, so that it cannot be said to have been proved to possess specific properties; and moreover, Klein has shown that in fulminating cases often only

a few ' commas ' are to be found, and those only in the mucous flakes of the bowel. The two views held at the present time are those of Koch and Klein respectively; the former believing that the comma organism is the cause of cholera, the latter regarding it simply as a consequence of the disease. In the absence of more accurate experimental evidence than we at present possess, no positive decision can be expressed on this point. VICTOR HORSLEY.

VILLOUS TUMOURS are so called from the resemblance which they present to the villi of the chorion. They grow in the bladder, breast, cerebral ventricles, intestine, larynx, rectum, and stomach. Formerly, all such tumours were looked upon as malignant, but pathologists of the present time class them under the two and groups of non-malignant papillomata malignant sarcomata and carcinomata.

The *Non-malignant* or *Papillomatous* forms are found in the bladder, rectum, and larynx. They consist of branched outgrowths from the mucous membrane of these parts. Each outgrowth is composed of connective tissue covered with a layer of tessellated or cylindrical epithelium, which readily separates when the tumour is macerated. In the centre of the outgrowth are an arteriole and venule, which communicate by a peripheral loop of capillaries. The capillaries are often dilated into small botryoidal appendages. The main papilla gives off secondary and these again tertiary papillæ, which are identical in structure with the parent stem. In this way we find long fimbriated processes arising from a small circumscribed base, such as have been described under BLADDER, Tumours of the. The villous tumours of the stomach are less complex than those just described, inasmuch as they consist of simple papillæ without secondary offshoots.

The villous papillomata undergo various forms of degeneration: thus, they may ulcerate or the delicate capillaries may rupture, and the blood escaping into the villi may be converted into pigment. On the other hand, the vessels may become calcified, or the villous tumour may become encrusted with a phosphatic deposit; the latter degeneration is especially liable to occur in the bladder, where the fringes float in the urine. The investing cells in some cases undergo colloid degeneration.

The *Malignant Villous Tumours* are either sarcomata or carcinomata. It is now recognised that a non-malignant or papillomatous growth may, in course of time, become converted into a malignant growth of similar microscopic appearance. The chief obvious difference between these two classes of tumours is that, in the non-malignant papillomatous growth, the epithelium is situated only upon the surface of the papillæ, and is therefore homologous, whilst, in the malignant varieties, the cells are found as well within as without the connective-tissue basis of the papillæ, and they are therefore heterologous.

The malignant villous tumours are either sarcomata or carcinomata of an epithelial or adenoid type.

The *Villous Sarcomata* are said by Billroth to grow from serous membranes, the cellular elements consisting of enlarged cells derived from endothelium, the stroma being formed of connective tissue. They are found growing from the membranes of the brain and from their nerve-sheath prolongations.

The *Villous Carcinomata* are either epithelial or adenoid in type. They grow most frequently from the stomach and urinary bladder, though they are occasionally found in other parts.

Epithelioma of the bladder occurs as a warty or villous excrescence of the mucous membrane, having the usual character of an epithelioma. The growth commences in the mucous membrane, and is covered with tessellated epithelium. It is recognised by its invasion of the submucous and muscular coats.

Villous cancer or duct cancer is a rare form of carcinoma occurring in the breast. It is described by Cornil and Ranvier as a tubular epithelioma, and by Rindfleisch as a cysto-sarcoma (fibrous or mucous). It is a malignant growth springing from the galactophorous ducts. The new growth obstructs these ducts, thereby converting them into cysts. Processes of fibrous tissue covered with columnar epithelium and containing blood-vessels, which may rupture, grow into these cysts. The growth has the appearance of an encephaloid cancer. A similar villous cancer may develop from the sweat or other simple tubular glands, such as those of the neck of the uterus and the soft palate.

Columnar epitheliomata grow from the glands of the large intestine, and cylindrical epitheliomata from the brain and orbit.

Villous growths of an innocent nature occur on the synovial fringes of bone in osteo-arthritis as the result of simple hypertrophy, and as granulations from the choroid plexus and Pacchionian bodies.

D'ARCY POWER.

VISION, Disorders of, from injuries of the head and spine.—The vision of one eye or of both may be impaired or destroyed, temporarily or permanently, by injuries to the head, even when the eye itself is absolutely unharmed. The commonest perhaps amongst these are fractures of the base of the skull, where the line of fracture runs through some part of the anterior fossa, in the neighbourhood of the optic foramen or of the lesser wing of the sphenoid. Cases of this kind are very often fatal, and it has been clearly established by Hölder and others, who have directed their attention to the state of the optic nerve in such injuries, that the sheaths of the optic nerve, subdural and sub-arachnoidal, one or both, are frequently distended with blood. This observation throws light on the cases where a patient discovers, on regaining consciousness after severe head-injury, that he has completely lost the sight of one eye—on the side, that is, where the line of fracture runs.

The blindness is, probably, due to pressure on the optic nerve by blood within its sheath, a view supported by the fact that no changes or signs of injury can be found in the eye itself, and that vision sometimes undergoes improvement, or even, it may be, restoration, as the blood is gradually absorbed. The result, in all probability, depends upon the amount of blood which has been extravasated, and on the state of the neighbouring circulation, matters on which, clearly, no opinion can be expressed in individual cases. If the amount of blood extravasated be large, it is not only unlikely that it will be altogether absorbed, but there is also a risk that, from its continuous pressure, some interference may take place with the nutrition of the optic nerve itself, and the ophthalmoscope may in course of time reveal signs of atrophic or other changes in the optic papilla. Whether treatment of any kind can be of any avail, in such cases, is extremely doubtful. The prognosis can only be unfavourable when absolute blindness dates from the moment of the accident, and consolation must be sought in the fact that one eye only has been affected, a circumstance dependent on the usual obliquity of the line of fracture, which thus involves only one optic foramen. *See* Optic Nerve, Diseases and Injuries of the.

Cases, moreover, may be met with in which, as the immediate result of severe injury to the head, there is impairment of vision of both eyes. Here it seems probable that the line of fracture, or seat of injury to nervous structures, lies posterior to the optic foramina, and involves the region of the optic chiasma or tracts. A careful examination of the fields of vision is essential, in such cases, to determine the seat of injury, whether it be in the optic nerve, which contains all the fibres going to the retina of its own side, or in the optic tract which contains the fibres running to the temporal half of the retina on its own side and the nasal half on the opposite. The phenomenon of homonymous hemianopia may therefore be an important diagnostic and prognostic symptom; for there seems to be a better chance of restoration of sight when the extravasated blood lies at the base of the brain, than when it is confined within the optic sheaths, from the fact that absorption can in all probability be more easily and speedily accomplished in that situation. *See* Perimetry.

The *prognosis* in all such cases, however, is bad, whether the loss of vision affects one or both eyes, and when the history of the injury warrants a belief that there is fracture of the base of the skull or some severe injury to the brain. To aid this diagnosis the surgeon must look for other signs and symptoms, bleeding from and deafness of one ear, subconjunctival extravasation of blood for example, and paralysis of special nerves. Yet, every such sign or symptom may be wanting, even in cases of severest injury; and the absence likewise of any evidence of damage to the eyeball itself, after careful ophthalmoscopic examination, may be the only clue, and that merely negative, that the loss of sight is probably due to the causes above-named.

As far, therefore, as pathological knowledge at present enables us to affirm, immediate one-sided blindness, after severe head-injury, is probably due to hæmorrhage within the sheath of the optic nerve, associated, in a large percentage of cases, with, or caused by, fracture passing near or through the optic foramen; whereas double blindness, complete or partial, is in the same circumstances probably due to basal hæmorrhage, with or without fracture in the middle fossa of the skull, which presses upon the optic chiasma or tracts. And yet hæmorrhage within the sheaths of one optic nerve is by no means invariably associated with fracture of the base, for cases are on record in which hæmorrhage in this situation has been found after injuries to the head, where there has been no fracture through or near the optic foramen, but where the extravasation has

been simply the direct extension of hæmorrhage at the base of the brain. This may occasionally happen, even when there has been a history neither of severe blow on the head itself nor of concussion of the brain, and the patient has perhaps only fallen heavily on his feet. The prognosis in such cases is probably more hopeful than when there has been fracture of the base, although an increase of the hæmorrhage is to be feared from vessels which were so easily ruptured, and are, therefore, probably, diseased.

In all severe injuries to the head, there may be more immediate damage to nervous structures themselves—rupture, for examplef of the optic nerve, laceration or rupture o the commissure, of one or both of the tracts Lesions such as these are hardly likely to occur alone. There is yet another class of cases where, after severe concussion-injuries of the brain, the vision of one or both eyes begins to be impaired some time after the accident, and where the immediate effects upon the sight were nil. In these cases, ophthalmoscopic examination frequently reveals the presence of changes in the optic disc, such as are seen in the various stages of optic neuritis from non-traumatic causes. Seeing that optic neuritis may advance considerably without any impairment of the normal acuity of vision, it seems highly probable that, in many cases where optic atrophy is discovered at a considerable length of time after head-injury, examination of the fundus might have revealed the early stages of neuritis, had attention only been called thereto by impairment of sight. Ophthalmoscopic examinations after injuries to the head have been, as yet, far too few to warrant any decisive opinion on this point, but in the not uncommon cases of optic atrophy, discovered at some distance of time from the accident, the changes in the fundus are probably the result of a neuritis which has run through its various stages without causing noticeable loss of vision, and which has gradually gone on to atrophy and blindness.

A routine use of the ophthalmoscope by surgeons is therefore most desirable, as thereby alone can a settlement be made of these various interesting points in connection with blindness arising after head-injuries, for it is useless to wait for the symptom of blindness before examination is begun. The changes must be observed at their very beginning, the time of their origin noted, and their progress recorded from day to day, for otherwise the opportunity of treatment will be lost, at the time when alone it can be of any service. In such cases, it is probable that the optic neuritis originally starts in connection with some basal meningitis, the result of injury, contusion it may be, of the substance of the brain. This seems to have been the sequence of events in a case brought before the Ophthalmological Society by Dr. Coupland, where total blindness supervened in about three weeks after a severe fall upon the head. The necropsy showed that there had been extensive contusion, both superficial and deep, of the brain without fracture of the skull; and a basal meningitis which 'in extent and disposition singularly imitated the favoured region of tubercular inflammation.' Cases like this throw light on the development of optic neuritis after severe head-injuries, even when there is no fracture; and in all probability the condition is much more common than is ordinarily supposed, from the simple fact that vision may be at first unaffected and therefore no ophthalmoscopic examination is made. At any rate, meningitis at the base has been found both with and without fracture, extending by direct continuity along the sheaths of the optic nerves, even within twenty-four hours of accident. Death is due in all probability far more to the severity of the injury to the brain than to fracture of the skull, but, if the patient survive, it must depend largely upon the amount and extent of the meningeal inflammation whether vision is restored or whether atrophy will result.

Opinions differ amongst surgeons as to the influence which the administration of mercury may have in helping the absorption of inflammatory products upon the membranes of the brain; but, looking to the ill-results which are pretty sure to follow from the organisation and pressure of lymph on the optic nerves, chiasma, or tracts, it is hardly right, by withholding mercury, to deprive the patient of what may be his only chance of complete recovery from the baneful effects of inflammatory exudation, the result of injury at the base of the brain. In all these cases it is desirable, if possible, to gain some definite information as to the exact site of the original blow upon the skull, for not only does this to a large extent determine the position of the basic fracture, but we may also learn therefrom at what point there is likely to be hæmorrhage or contusion of brain-substance from *contrecoup*. Impairment of the sense of smell from damage to the olfactory bulbs is frequently caused by severe blows or falls on the back

of the head, and the like phenomenon of injury to, or in the neighbourhood of, some part of the optic nerve apparatus, may be caused by injuries apparently inflicted at remote parts of the skull. It is not inconceivable, moreover, that hæmorrhage may occur from injury in the substance of the brain at such a site as to cause amblyopia by involving the visual centres. A careful examination of the field of vision in both eyes can alone lead to a diagnosis, together with accurate knowledge of the results of experimental and pathological observation as to the central origin of the nerve fibres which go to different parts of the retinæ.

Again, vision may be impaired by the more direct pressure of blood upon the eyeball itself by large extravasations within the orbit, which may even cause exophthalmos. Here is a definite physical sign of blood-extravasation after injury, which of course varies with the amount of blood poured out, and usually occurs immediately after or within a few hours of the accident. Pain in the orbit and impaired movement of the eye are likewise present in such cases; but it is by no means clear how vision may be disturbed, whether by immediate pressure on the eye or by pressure on the optic nerve. Ophthalmoscopic examination has revealed both diminution in the size of the arteries and distension of the veins, as if from pressure; and the ultimate result no doubt depends upon the length of time such pressure lasts. In all probability there is some more serious injury than simple blood-extravasation, which will lead to a fatal issue at an early date; but, if this be escaped, the surgeon will do well by careful pressure to restore the eye to its natural position, and so help, moreover, in the absorption of the blood.

Recovery is usually complete, for, unless it be a gunshot accident, the eye itself is rarely injured, so securely is it protected from concussion by its various cushion-like surroundings. A risk there is, however, in such cases that the hæmorrhage may be from some vessel of more than capillary size, and that aneurism may ultimately result. Upon the position of the aneurism the character of the impairment of sight will depend, whether the pressure thereof be upon the optic nerve, upon the globe itself, or on the nerves which supply its various muscles. *See* Orbital Aneurism.

Severe injuries of the head may also cause impairment of sight, or rather interference with perfect binocular vision, by simultaneous damage to one or more of the nerves which supply the muscles of the eye. Here, again, the symptom diplopia may be developed either early or late—early, when in all probability the nerve has been completely torn through at the moment of the accident, or is pressed upon by rapidly extravasated blood; late, when the pressure of meningeal thickening or inflammation interferes with the proper function of the nerve or nerves so affected. The diagnosis of the various forms of diplopia are not dealt with in this article. The muscular paralysis may ultimately pass away, but let it be remembered that even in traumatic paralyses of individual ocular muscles, the course of recovery may perchance be retarded by a syphilitic element, the treatment of which will best remove the special symptoms apparently due to injury alone. *See* Ocular Muscles, Affections of the; Strabismus.

The effect which severe blows in the neighbourhood of the orbit have upon vision, has long been a matter of observation amongst surgeons, and, in pre-ophthalmoscopic days, it was generally believed that vision was impaired through the influence of the fifth nerve, which, being damaged in one of its branches, wrought some change by reflex or other agency upon the nutrition of the eyeball itself. It is very questionable, however, whether such is the real sequence of events, and whether there is any true relationship of cause and effect between injury in this region and ultimate deterioration of sight; although it seems not altogether unreasonable to conclude that a severe lesion, causing neuritis, for example, of the supra- or infra-orbital branches of the fifth nerve, might indirectly produce some effect upon an organ lying so near, and supplied by other branches of the same cranial nerve. The ophthalmoscope, however, has shown that, if we exclude the cases where a severe blow near the orbit has caused damage to the eye itself, rupture of iris or lens-capsule, detachment of retina, rupture of choroid, or hæmorrhage into the vitreous, there remains hardly any case to support this doctrine; and lesions which may cause severe injury to one branch of the fifth, the infra-orbital, in fractures of the upper jaw, are not commonly followed by any impairment of sight. This result has apparently arisen only in cases where the injury has had the indefinite description of a severe blow in the neighbourhood of the orbit, and no ophthalmoscopic examination has been made. It is true that many cases are to be found, in medical literature, which seem to establish

the fact that injury to a branch of the fifth may lead ultimately to amaurosis; but this also is not less remarkable, that cases of the kind are becoming rarer day by day, as the ophthalmoscope throws light on hitherto unseen parts of the eye itself, and as pathological investigation shows by what central lesions sight may be affected or destroyed.

Passing to other and more special forms of accident, we find that impairment of sight is a not uncommon complaint of patients after railway collisions.

The symptom varies much in importance in different cases, but it is usually a passing condition, wholly independent of structural change. It cannot indeed be said that railway accidents give rise to any special or characteristic form of loss of vision, for the impairment, whether temporary or lasting, differs not in the least from that which may be induced by injuries in other accidents, of every form and variety. The circumstances of a railway accident are merely such as to provide the requisite causes of certain disorders of vision. The commonest is simple asthenopia, which may or may not be associated with some error of refraction. The patient complains that reading or fine work is difficult or impossible, because the lines run together and rapidly become blurred, and added thereto, if the effort be continued, is pain about the orbits and brows. Fatigue is, in fact, very early induced by the muscular effort of accommodation; fatigue of the same kind as renders any sustained effort, whether of mind or body, impossible during the state of general weakness and prostration which are the very common result of the physical and mental shock sustained in a railway collision. And, as might be expected, early fatigue of accommodation is more likely to arise in those who have some error of refraction, and in whom, therefore, an extra muscular effort is needful to bring objects to a focus on the retina.

It is not after railway accidents only that such defects may be discovered. The same thing happens not infrequently in the course of an exhausting illness, in the period of weakness following it, or in that which is induced by prolonged suckling. In a previous state of health, the muscular strength may have been adequate for the purposes of accommodation, and the defect has been unknown. Illness prostrates and the defect is revealed, for all muscular power is weakened, whether of the limbs, of the heart itself, or of the eye. That the discovery should cause considerable alarm, after an accident, is not to be wondered at, nor is it surprising that persons, so suffering, should with difficulty be led to believe that some more serious injury has not been inflicted, and that the failure of sight is not the beginning of an impairment which will end in blindness because of some grave damage to nervous centres. Careful testing with lenses will usually establish the diagnosis and indicate the treatment; but as long as the condition of nerve-prostration lasts, it is idle to hope for complete relief for the asthenopia by the use of glasses. Returning strength alone can restore the ciliary muscle to its natural vigour, but it is only in cases of emmetropia, or in the slighter grades of ametropia, that the patient will probably be able in the future to dispense with glasses.

When the refractive error is considerable, glasses will in all probability be found a permanent necessity; but, if the asthenopia is simply due to general weakness alone, the trouble will completely pass away. The same remarks apply to those in whom presbyopia is just commencing; and when this condition is well advanced, any severe shock or illness will in all probability entail a further presbyopic change, which will call for stronger lenses. Given, then, after railway collision a case where there is no question as to the genuineness of the symptoms, asthenopia becomes a symptom of some value in forming an estimate of the general muscular and nervous prostration. It is in these cases that muscæ volitantes are so often troublesome; but they are of no pathological significance, being due to the presence of small floating bodies in the vitreous. In the severer forms of neurasthenia after railway collision, we sometimes meet with a considerable degree of photophobia; but it is impossible to say on what the condition depends. It is associated with extreme general prostration, and does not seem to have any definite pathological basis. The state of nervous exhaustion from shock is often accompanied, perhaps is caused, by extreme feebleness of circulation, and it is possible that asthenopia may in some cases be due to a general retinal anæsthesia so to say, whereby there is concentric limitation of the field of vision. To cases apparently of this nature the term 'reflex amblyopia' has been recently given by Mr. Priestley Smith (*Ophthalmic Review*, May, 1884). The condition seems to be independent of any discoverable pathological change, and the tendency is

towards complete recovery, when the general health has been restored.

Symptoms such as these are naturally extreme in persons of an hysterical or emotional temperament, and when it is remembered that an emotional state is frequently induced in both sexes by the shock and fright of a railway collision, and that hysteria—using the term in the very broadest sense—is so commonly developed thereby, it is not strange that they should be common results of such accidents, and it is needful to exercise the greatest caution in forming a diagnosis. Complaints of bad sight are, moreover, very open to exaggeration, and the difficulty of diagnosis may often be great when we have to rely upon the statements of the patient alone. Let care be taken that normal physiological varieties, such as may be seen in the colour of the fundus oculi, in the distribution of the vessels, or in the appearance of the disc and its margin, be not mistaken for pathological changes. Certain it is that pathological changes as the result of railway accidents, spinal or otherwise, are extremely rare; and this is the common experience of ophthalmic surgeons and in ophthalmic hospitals, although the vast number of persons who have been hurt in railway accidents might have afforded many examples of eye-disease. It is in cases of railway injury, moreover, when the prospect of compensation opens out so great a temptation to exaggeration, imposture, or untruth, that the surgeon may be called upon to decide the important question, whether and how far some existent pathological condition is due to any injury received, or whether it has preceded the accident, and is really altogether independent of it. A patient may assever, with every semblance of truth, that his sight has been impaired or destroyed by the accident, and ophthalmoscopic examination may reveal pathological changes amply sufficient to account for the defect, or it may fail to find any lesion at all. In the latter case it will be essentially necessary to make repeated examinations, at short intervals, to discover whether any changes in the fundus oculi of an atrophic character do gradually become developed, before speaking with certainty as to the truthfulness of the patient; while, if other circumstances of the case throw doubt upon his *bona fides*, and special examination with prisms and coloured glasses, &c., referred to in another article, detects unquestionable flaws in his statements, the absence of pathological changes will of course tend to support the conclusion that the loss of vision is either imaginary or assumed. *See* Vision, Feigned Disorders of.

More difficult, however, of decision and certain etiological diagnosis, are the cases where pathological changes undoubtedly exist and the patient at the same time assures you that his failure of sight, or even his blindness, dates from the time when he was subjected to injury. Are the discovered changes due thereto either wholly or in part, or have they been pre-existent and been aggravated by the alleged injury sustained? In the decision of these points, on which important medico-legal questions may depend, certain possibilities must be borne in mind. The patient may, for example, have been totally ignorant of his blindness or failure of sight in one eye, even though of long standing. This is a matter of common observation, and it is well recognised that a cataract of one lens may have advanced to almost complete opacity before the patient accidentally becomes conscious of the fact; and the same ignorance may at times be displayed in the case of other and more deep-seated lesions. That such discoveries should coincide with, or shortly follow, the receipt of railway or other injury, is not to be wondered at, when it is remembered that asthenopia due to failure in accommodative power is so common after such accidents, and that a patient then for the first time has his attention specially directed to his eyesight.

The surgeon may also meet with cases where a patient has been perfectly aware of his defect, and yet persistently declares that his old complaint is really new, and therefore presumably due to the injury sustained. Granted that he has had an adequate experience of eye-diseases, the judgment of the surgeon is far more valuable than the asseverations of the patient, in the presence of familiar pathological changes, for it may be to the great pecuniary advantage of the patient intentionally to deceive. But, given an instance of perfect truthfulness on the part of the patient, no more difficult questions can well present themselves to the surgeon than the real causation of the various pathological conditions which may be met with after railway accidents. Happily, such questions but seldom arise, and they are likely to be less common as familiarity with the ophthalmoscope increases in the hands of the practitioner, and as he becomes better acquainted with the real nature of the injuries to which railway accidents commonly give rise.

The writer can call to mind a case of well-marked choroido-retinitis, and opacities in the vitreous of one eye of a patient who had received a cut over the left eyebrow, and slight momentary concussion, and who first noticed, or complained of, failure of sight in the left eye some three weeks after he had been in a railway collision. He had some years before lost the sight of the other eye from injury, and presumably therefore he would be able to say, with tolerable certainty, how much his vision had changed after the accident. The fact that he had observed no failure of sight for about three weeks seemed fair evidence that no direct blow of any severity had been received upon the eye itself. The parts about the macula and disc were perfectly healthy, but towards the equator were patches of widely-scattered choroidal atrophy due to disseminated choroido-retinitis, which none of the surgeons who examined him would have ever connected with injury in the absence of the patient's own statements, the changes being in no wise different from those met with from other constitutional causes. In the absence of a history of such causes, could a blow upon the head, or in the neighbourhood of the orbit, have transmitted such a physical shock to the globe as to rupture minute vessels in the choroid and retina, and cause scattered specks of hæmorrhage which became foci of irritation, and so set up choroido-retinitis? It seemed hardly likely that such changes, thus induced, would affect all parts of the equator, for violence would most probably produce damage at one particular spot. The appearances and the history alike negatived the supposition that recent injury was the cause of the pathological changes, and the general conclusion arrived at was that the choroido-retinitis preceded the accident, and was perhaps aggravated—who could really say?—by the blow sustained. The asseverations of the patient and the opinions of the surgeons were thus diametrically opposite, and in the end large compensation had to be paid. Years after this claim was settled and pecuniary compensation had been enjoyed for the alleged injury, it was learned that the failure of sight had really existed before the accident, and had always been attributed to the injury to the other eye. These facts, however, were carefully concealed after the railway collision, and the problem to be decided by the surgeons was as difficult as could well be conceived.

Like difficulties, of which other examples might be named, have arisen, and will again arise in other cases, and this example has been detailed at length to point the lesson that the surgeon should, in such instances, place less reliance on the patient's statements than on the results of his own examination. Let him learn an accurate account of the accident, and of the precise mode whereby injury was sustained, and let him apply his knowledge of ordinary disease to an elucidation of the disease which he finds before him. Neither here nor in any more elaborate treatise can any special rules be laid down for guidance or diagnosis in these cases of railway injury; the tact, judgment, and experience of the surgeon must avail him for the task of decision. Again, it must not be forgotten that the severe shock and fright of a railway accident very often give rise, in both sexes, to profound functional disturbance of the nervous system, and that, in the state of general neurasthenia so induced, there are likely to arise numerous varieties of functional or so-called hysterical disorders in which vision may be affected.

Complete blindness of one or both eyes, diminution of the normal acuteness of vision, limitation of the field of vision, with loss or diminution of the colour-sense, may perchance be met with, and their true significance can only be determined by the fact that they exist in conjunction with other obvious nervous disorders. Hemianæsthesia, for example, has been observed in both sexes after the shock of a railway collision; and anæsthesia may likewise involve smaller and circumscribed areas of the cutaneous surface. It is very essential to look for, and if possible discover, such evidences as these of functional nervous derangement, for their presence may form a most valuable aid to diagnosis when other features of the case may have been wholly obscure, and a diagnosis thereof difficult or impossible. Amongst them are various defects of sight of a purely functional nature, in which the ophthalmoscope reveals no evidence of structural disease. Such cases are by no means rare, in males as well as females, after railway collision or other severe accidents, and the surgeon will do well to bear the possibility of their occurrence in his mind when making his investigation.

Of greater importance, however, than these cases of simple functional disturbance, are those where some obvious pathological change is present in the fundus oculi, as a consequence or accompaniment of damage

to nervous structures remote from the eye itself. The association of morbid changes in the optic nerve with cerebral disease is a matter of daily observation; but of not less interest is the possibility of similar changes being induced by injury or lesion of the spinal cord. Many years have gone by since Dr. Clifford Allbutt first asked the question whether disturbances of the optic nerve and retina commonly follow spinal mischief, and it cannot be said that precise information on the subject is as yet anything but fragmentary. Isolated cases have from time to time been published, which show that morbid changes in the fundus oculi are sometimes met with in association with injury of the spinal cord, but there is little real evidence to establish the relationship between them of cause and effect. Optic atrophy, it is well known, is often found in cases of tabes dorsalis—locomotor ataxy—and other disseminated scleroses of the nervous system, and may, in fact, be one of the first signs of disease; but it can hardly be said that the atrophy is the result of the sclerosis in the spinal cord, and there are numbers of cases where advanced degeneration in the spinal cord has had no concomitant changes in the optic nerve. Nor is there any clearer connection between the two in cases of spinal injury. One thing only seems tolerably certain—that the higher the seat of injury to the cord the greater likelihood is there that changes may supervene in the eye, and the sooner are such changes prone to arise.

As to the nature of these changes observers seem pretty well agreed that optic atrophy, such as is met with in the system-diseases of the cord, is not seen after spinal injury, but that there may be a condition of hyperæmia of the disc and adjoining parts. In Dr. Allbutt's words, 'the retinal arteries do not dilate, but become indistinguishable, while the veins begin to swell and become somewhat dark and tortuous. The disc then becomes uniformly reddened and its borders are lost, the redness or pinkness commencing with increased fine vascularity at the inner border, which then so invades the white centre and the rest that the disc is obscured or its situation known only by the convergence of the vessels.' Such changes are of slow development, and their tendency is to end in resolution rather than in atrophy. They seem rather to point to circulatory disturbances than to primary change in nerve-tissues; but it must be confessed that the number of observations, or at any rate of recorded observations, is as yet far too few for any settled opinion on the subject, and not only is a greater number of observations necessary, but post-mortem examinations also are needed to throw light on the association, if there be any, between cord-lesions and optic changes. The same kinds of appearances have been recently observed by Mr. Bruce Clarke in cases of spinal injury, and have been recorded in *St. Bartholomew's Hospital Reports* (vol. xvi.), the distinguishing characteristics of them being that the hyperæmia was seen early and was essentially transient. Thus, in a case of fracture of the fourth, fifth, and sixth cervical vertebræ with complete division of the cord at the level of the fifth and sixth, there was noted on the third day 'well-marked hyperæmia with considerable œdema of both discs; a good deal of effusion obscuring the vessels in many places.'

The facts, then, seem to be established so far that occasionally after spinal injury, and most commonly when the injury is high up, changes in the fundus oculi are to be found, consisting chiefly of a hyperæmia, either transient or longer continued, which leads to obscuration of the disc itself; and, further, that this hyperæmia may or may not be associated with, or give rise to, impairment of vision. The actual relationship between the two conditions is not, however, by any means clear, and no observations have yet been recorded to shake the suggestion of Dr. Clifford Allbutt that the changes are probably dependent on a greater or less extension of the meningeal and vascular irritation from the spinal cord up to the base of the brain. For it is well recognised that encephalic meningitis is a not uncommon accompaniment or extension of spinal meningitis, and it seems highly probable that optic changes arise only when this extension has taken place. The same conclusion, as to the absence of any more immediate relationship, seems to be borne out by those cases of disease in which acute optic neuritis has been found associated with acute myelitis of the spinal cord.

A goodly number of such cases have now been published, but it is noteworthy that in several of them the optic neuritis has actually preceded any evidence of mischief in the spinal cord. Markedly was this the fact in a recent case brought before the Ophthalmological Society by Dr. Sharkey, where failure of sight and acute optic neuritis began at least a month before the myelitis of which the patient ultimately died. No connecting link whatever could

be found *post mortem* between the neuritis and the myelitis, and the inference seems inevitable that both were merely the widely separate manifestations of one disease arising from some common cause. At any rate, the association of the two phenomena is so rare, that it is impossible to lay it down as an established pathological fact that optic neuritis is caused by myelitis; nor do present facts allow of our saying more than this, that the less serious phenomenon of optic hyperæmia, whether transient or of long duration, is sometimes found accompanying injuries at the upper part of the spinal column. Be the connection, however, what it may, it is obvious that such morbid changes in the fundus oculi may be of considerable diagnostic importance after obscure injuries to the upper part of the spine.

Although the significance of these pathological changes in the deeper parts of the eye is a matter of uncertainty, the more visible phenomena of alterations in the pupil, with which we have next to deal, seem to have a closer relationship of cause and effect with injury to the upper part of the spinal cord, and of the nerves which come off from it, of those which go to form the brachial plexus, and of the sympathetic nerve itself. Injury of any one of these various nervous structures may give rise to changes in the size and activity of the pupil, which in the main confirm the results of experimental observation, both as to the origin of the nerve-trunks and their association with the sympathetic, and of the connection which this in its turn has through them with the upper part of the spinal cord. Let it be noted, however, in the first place that, other causes having been carefully excluded, the size of the pupil gives a very fair indication of the patient's general nervous tone; that if the tone be low the pupils are often large, and that dilatation of pupils may be due to defective tone of the retina and nerve-centres, and to the fact that a larger supply of light is necessary in such conditions. This has been pointed out by Mr. Hutchinson, and his observation certainly holds good in the state of general nervous prostration which is so common after the severe shock of a railway accident.

Here it is impossible to enter into those physiological questions which are of great interest and importance in connection with the sympathetic nerve and its association with the eye. Suffice it that well-marked oculo-pupillary symptoms are induced both by division and irritation of the sympathetic in the neck, and that the same phenomena may be caused by division or injury of the lower roots of the brachial plexus and of certain regions of the spinal cord. Leaving aside the well-known vaso-motor phenomena which follow division of the sympathetic, phenomena which seem rather to affect the vessels of the side of the head and neck than of the eye and orbit, together with alteration in temperature of the affected area, the symptoms caused by division of the sympathetic in the neck are contraction of the pupil—paralytic myosis—retraction of the globe of the eye, diminution in size of the palpebral fissure, some flattening of the cornea, and occasionally slight rolling inwards of the eyeball. Irritation of the sympathetic gives rise to exactly opposite phenomena, and a region in the spinal cord extending from about the sixth cervical vertebra to the third or fourth dorsal has been named the 'regio cilio-spinalis,' and by Bernard the 'centrum oculo-pupillare,' because irritation thereof causes the same phenomena as irritation of the sympathetic trunk itself. While, however, these symptoms may readily be induced experimentally on animals, as to injuries of the spinal cord in man little more can be said than this, that sometimes one or both pupils are contracted, or non-dilatable, as in some cases recorded by Brodie, sometimes one or both may be dilated, and that these opposite conditions are in all probability due to differences in the nature and precise position of the lesion. One cannot say for certain what lesion of the cervical or upper dorsal cord it is which will certainly give rise to this or that form of oculo-pupillary symptoms, but recorded observations seem to show that paralytic myosis is much more common than mydriasis. Division of the trunk of the sympathetic, however, gives rise with comparative certainty to the appearances already named.

With reference to this paralytic myosis it must be remembered that the condition is not one of spasm of the circular fibres of the iris, but that the pupil has simply lost the power of dilatation because of palsy of its dilator fibres, and that, in a fairly bright light, there may therefore be no noticeable inequality in the two pupils. This is only revealed when the patient is placed in a dull light; but even then we must beware lest the condition be mistaken for paralysis of the third nerve with consequent mydriasis, and it is necessary, therefore, in order to arrive at a correct diagnosis, to observe the state of the pupils both in light and shade.

'Inequality in the size of the pupils,' Mr. Hutchinson wrote many years ago, '*the smaller one being the fixed one*, is then the cardinal symptom of paralysis of the sympathetic, just as inequality of the pupils with the larger one fixed is the cardinal symptom of paralysis of the third nerve, as far as supply to the iris is concerned.' Paralytic myosis is the most pronounced and most usual symptom, retraction of the eyeball being by no means well-marked in all cases. This latter phenomenon is due, in all probability, to paralysis of the musculus orbitalis, whereby the recti are enabled to draw the eye deeper into its socket, and is often more marked in animals after experiment than in man. The muscle is probably less well-developed in man than in animals, and may perhaps even be absent, so that this symptom of its paralysis is very variable. The same variability is also to be noted in the narrowing of the palpebral fissure, which may be due in some degree to the lids having lost the natural support of the eyeball, or to paralysis of the muscular fibres in the lids, or 'musculus orbitalis' of Müller, which are supplied by the sympathetic. In one of Weir Mitchell's cases of injury of the sympathetic in the neck from a bullet, the pupil was not only contracted, but was also slightly deformed, being oval rather than round. There was also slight ptosis, and the outer angle of the eye seemed to have dropped a little lower than the inner. Some or all of these phenomena, it must be borne in mind, may be induced by the pressure of new-growths on the sympathetic, and it is well recognised that oculo-pupillary changes may give valuable diagnostic help in suspected aneurism of the root of the neck.

All that has been written above with reference to the symptoms of paralysis of the sympathetic might be repeated in a description of the symptoms caused by rupture of the roots of the brachial plexus, many cases having been published in which the same oculo-pupillary phenomena had been caused by this injury. Symptoms, of apparently greater physiological than surgical interest, may thus be of considerable diagnostic importance in deciding between cerebral and peripheral lesion as a cause of extensive palsy of one arm, the result of injury. There seems to be a general consensus of opinion that no lasting changes are to be seen in the retina in the subjects of these injuries, although, in experimental observation on rabbits, after division of the sympathetic some hyperæmia has been noted. Alterations in temperature do not usually last long, but minute observations on this point in the human subject are as yet wanting. The inconvenience to the patient appears to be small. Slight difficulty in accommodation is all that has been observed, even though the paralytic myosis may have lasted for years. There is no evidence to show that the nutrition of the eyeball is interfered with in the least; but it has been pointed out by Mr. Hutchinson that occasional giddiness is complained of, owing to 'inability on the part of a tract of the vaso-motor nerve to regulate the calibre of the cerebral arteries, and thus control the supply of blood to a certain portion of the brain.' It is possible also that this may likewise be the cause of the dimness of vision which is sometimes felt in these cases; but, if with Eulenburg and Guttmann we regard the functions of the sympathetic as divisible into three groups—the oculo-pupillary, the vaso-motor, and the trophic—it must be admitted that it is in the domain of the first of them that changes usually fall under the notice of the surgeon.

HERBERT W. PAGE.

VISION, Feigned Disorders of.—What may be designated the real disorders of vision are dealt with under the various heads of ACCOMMODATION; AMAUROSIS; AMBLYOPIA; REFRACTION, Errors of, &c. In this article only the feigned or simulated disorders will be considered. Even these will be discussed rather from the diagnostic than from the pathological point of view.

SIMULATED AMAUROSIS.—Amaurosis is occasionally, though not very frequently, simulated, certainly less frequently than amblyopia or mere impairment of vision, and for the obvious reason that it is much more difficult to keep up the deception in the latter than in the former case. A single slip or act of forgetfulness will discover the one, whilst it may easily pass unobserved in the other. The simulation of amaurosis in one or in both eyes is practised by those who wish to escape conscription, in countries where military service is compulsory, and is also sometimes observed as one of the vagaries of hysteria and pregnancy. It may be pretended, and with considerable chance of success, by those who have some real defect of vision, such as may result from cloudiness of the cornea, lens, or of the fluid media of the eye, or from some lesion of the optic nerve.

Simulation of Bilateral Amaurosis.—When amaurosis of both eyes is simulated, the surgeon who is called upon to determine whether a fraud is being prac-

tised or not must take all the circumstances of the case into consideration, and reflect whether any probable or sufficient motive exists for its perpetration. As a general rule, the dilatation of the pupil in amaurosis is moderate, and no contraction of the iris can be observed on sudden exposure to bright light. Extreme dilatation excites suspicion that atropine has been employed. The discovery of an impostor pretending to be blind may be, and has been, effected by persistent, though unobtrusive, watching; by observing whether the patient avoids obstacles, picks up coin placed in his path, or performs any act requiring vision. As a rule, some physical changes are observable in the eye with the aid of the ophthalmoscope, such as white atrophy of the optic disc, hæmorrhages or inflammatory changes in the choroid or retina, especially at or near the yellow spot.

Simulation of Unilateral Amaurosis.—The movements of the iris assist the surgeon in the diagnosis of simulated unilateral amaurosis. When healthy eyes are suddenly exposed to light, or are made to converge upon a near object, both pupils can be seen to contract. Moreover, if one eye be shaded whilst the other eye is alternately exposed to light and darkness, it will be found that the pupil of the shaded eye contracts and expands simultaneously with the other. This is termed the consentaneous action of the two pupils. In addition, it may be remarked that when a near object is intently regarded, contraction of the pupils occurs, which is a movement functionally associated with the act of accommodation. The reaction of the pupil to light shows that the retina is sensitive to light, and that the impression is conducted to the brain through the optic nerve, and occasions a reflex impulse to be propagated through the third nerve. This may be unattended with conscious perception of light, but it is suggestive of simulation. Consentaneous action, with the play of the opposite pupil when one eye is perfectly blind, may occur, though it is usually feeble in real amaurosis. The absence of any movement of the pupil in one eye, when exposed alternately to light and shade, whilst contraction and expansion occur simultaneously with the movements of the healthy eye, would supply strong evidence of the genuineness of the complaint. Dr. S. Baudry remarks: 'When no information can be gained from direct inspection, we must adopt physiological proceedings, which are for the most part of the nature of a surprise, and, as several of them depend on the accuracy of the statements of the patient, it is necessary for the surgeon to see that he does not close one eye, and to state frankly that, if he persists in doing so, the experiment will be regarded as having demonstrated the excellence of his vision in the eye declared to be at fault.'

In simulated unilateral amaurosis, a method in common use for its discovery is to cover the sound eye, and then for the surgeon to make, with a pencil or penknife, a sudden stabbing movement. Reflex closure of the lids on the first attack, if the patient sees, is almost unavoidable, or can only be overcome by considerable practice. A second method is that of Dujardin, to place before the sound eye an ordinary convex glass, 16 D, and place the patient at twenty feet from the usual test-types; if he is able to decipher any letters, the eye complained of is not blind. A third method is that of Javal—viz. to interpose a ruler held vertically between the sound eye and a line of print: words will be read which the surgeon, by a previous experiment on himself, knows could not be seen except with the eye in which blindness is simulated. Stilling recommends, for the discovery of the fraud, a test with coloured glasses. A word is placed before the patient, one half of the letters of which are red and the other half green, painted with transparent colours on an opaque ground. In 'friend,' for example, 'f, i, n,' are green, and 'r, e, d,' are red. Then, whilst leading the patient to believe we are testing the healthy eye, we place before it a red glass, the colour of which exactly corresponds with that of the red letters. This will permit the healthy eye to see the red letters, but will altogether prevent the green from being seen, so that if the patient be really amaurotic in the eye he declares to be blind, he will say he sees the letters 'r, e, d.' In the event of his recognising all the letters, and reading the entire word 'friend,' it is clear that he is perceiving the green ones, 'f, i, n,' with the eye he states to be blind; and by having a set of coloured types similar to those of Snellen, we may go a step farther, and measure the visual acuteness of the impostor's blind eye.

Another method is by means of prisms. In normal vision the eyes converge upon the object, and the divergence or wandering of an eye, when an object in near and middle distance is fixed, is strong presumptive, though not absolutely certain, evidence of some imperfection in its vision. By means of a prism, it is not difficult to make one eye wander without the control of the

patient in certain directions, and the movements which may be observed when vision exists in both eyes constitute the method of Wetz. In this method, a prism of about 14° is placed before the eye stated to be blind, with the base outwards. In order to obtain single vision, if the patient sees with this eye, he rolls it inwards, and again rolls it outwards when the prism is withdrawn. This movement and the subsequent rectification do not take place in cases where one eye is really blind. Berthold has suggested a slight difference in the application of this method—namely, the rotation before the supposed blind eye of the prism, when it will be found very difficult to read small print or decipher small signs, in consequence of the superposition and interference of the images.

The method suggested by Von Graefe, as modified by Baudry, consists in puzzling the patient with double images by placing a prism before one eye. The proceedings should be divided into two stages or periods. The first should be directed to making the patient comprehend, what, as Giraud-Teulon observes, he often knows and believes beforehand, that he may have double vision with one eye. For this purpose the blind eye or eye supposed to be blind is covered, a prism with the base upwards is brought upwards till it divides the pupil horizontally into two halves, and he is directed to look at a distant candle; he at once sees two images, one above through the natural pupil, and the other through the prism, the latter being projected below the other. This is tried several times, and in various ways, until the patient is satisfied of the fact; then, apparently unconsciously and without display, and as though by forgetfulness, the supposed blind eye is set free, whilst at the same moment the prism is raised so as to cover the whole pupil. If the patient still sees two images, the simulation is exposed.

A modification of this method has been devised by Galezowski, which consists in using a double refracting prism of Iceland spar, a method that has been again improved upon by M. Monoyer, who employs two prisms united by their bases, by which means simple or binocular diplopia may be produced at will, according to whether one of the prisms or the line of junction is in front of the pupil.

The method in which the stereoscope is utilised is also employed for the discovery of simulated monocular blindness. In this the photograph is replaced by a sheet of white paper, divided into two equal parts by a vertical line. Near the top of the sheet, at a distance from the vertical line of two centimètres, are symmetrically fixed two wafers of different colours, say, red on the right and green on the left; near the bottom of the page, and at a distance of five centimètres from the vertical line, two other wafers are placed, also symmetrically, say, blue on the right and black on the left. If binocular vision exists, the wafers distant two centimètres from the vertical line give crossed images, whilst those distant five centimètres give direct images. If an eye is really blind, supposing it to be the right, the patient would see the red and the blue.

Simulation of Amblyopia.—The simulation of amblyopia is more common than that of amaurosis. He who pretends to be completely blind, requires to be constantly on his guard, lest by some unwary movement or observation he betrays that he possesses vision; whilst the man whose vision is only, according to his own account, dim, may act in a way that may indeed excite suspicion or distrust, but is hardly sufficient to convict him of imposture. Yet there have been men, who, pretending blindness, have been so collected as to avoid all the traps laid to expose their deceit, and even, at considerable risk, to walk without hesitation into water or into a pit. Before the invention of the ophthalmoscope, the objective examination of the patient ceased with mere inspection of the eye; and dilatation and immobility of the pupil, with a particular and easily imitated gait, were regarded as most important reliable signs of blindness. But even these were known to be absent in some cases of genuine amaurosis; and so many causes of this affection existed, of which no account could be given, that when such simple proceedings as the placing of a coin or other object in the path of the supposed patient failed to surprise him, no other course was left than that of watching him, which soon became wearisome, and was only continued for a period so short that he was, without much strain on his attention, able to maintain the deceit. The use of the ophthalmoscope has rendered the simulation of blindness far more difficult. Yet it must be admitted that, even with all the aid this instrument affords, cases still occur in which, on the one hand, the most careful examination fails, for a time at least, to discover the slightest disease in the interior of the eye; whilst, on the other hand, it sometimes reveals conditions which, if the patient declared he was blind, would be regarded by any ophthalmic surgeon as sufficient to

justify his statement, and which may yet be compatible with very good and useful vision. To meet these difficulties, various methods have been adopted, some of which depend for their success on the statements of the patient, and require considerable intelligence on the part of the surgeon to render them reliable, whilst others rest on circumstances beyond the control of the simulator.

It not infrequently happens that an artisan receives an injury to one eye which temporarily incapacitates him from work, and, his club ceasing to furnish supplies, he seeks to prove that the lesion is permanent, and founds a claim against his employers. He may declare that one eye is completely blind, or only that the acuteness of vision in it is so far dulled that it seriously interferes with his work. The former case is more easily discovered than the latter, but, in both, circumspection is required on the part of the surgeon. He should first make a careful ophthalmoscopic examination and satisfy himself whether serious organic mischief is present or not, whether the media are clear, whether there is any hæmorrhage or effusion, whether the disc presents signs of atrophy, and whether the vessels are normal in their position, colour, size, and course. He should then proceed to test the refractive power of the media by retinoscopy or by means of the ophthalmoscope, for hitherto unsuspected and unknown defects of refraction are sometimes rendered conspicuous by the loss of accommodation which follows a sharp blow on the eye.

It is, of course, useless to place the patient before a set of test-types and ask him what he can see. He either says that one or both eyes are blind, or admits only a certain amount of vision. Where both eyes are stated to be blind, the proceedings already mentioned under the head of *Simulation of Bilateral Amaurosis* must be adopted; but, when only impairment of vision in one or both eyes is complained of, something may be learnt from careful observation of the patient's behaviour in regard to test-types. If, for example, he can make out letters of a given size at a certain distance, he should be able to read letters of a quarter this size at half the distance, and of four times this size at double the distance, or at least any great discrepancy should awaken suspicion. Again, a lens of slight magnifying power may be placed before the eye or eyes, and if he admits that he sees a little better, it may be somewhat ostentatiously and positively stated that a lens of double the power will further improve the vision though it will by no means make it perfect. The patient's suspicions being allayed, in stead of adding a second convex lens, a concave one of the same power may be added, which, of course, neutralises the first, and has no more effect than a piece of plane glass. Yet the patient will sometimes name letters far smaller than those which he at first stated were the extreme limit of his vision.

If no defect can be discovered, and blindness of one eye be declared to be present, it must be borne in mind that such blindness may result from shock to the retina (*commotio retinæ*), as from blows with champagne-corks, in which case, however, if the blow has not been very severe, recovery usually soon follows; or, in cases of falls on the head, from injury to the optic nerve in the optic foramen, in which case, white atrophy usually soon follows. If, however, doubt exist as to the statement of the patient, attention must now be paid to the state and reactions of the iris. In amaurosis, the pupil is usually, but not always, dilated and motionless, and it can be, as is well and generally known, rendered so by atropine, which is therefore used for the purpose by impostors.

As a means of diagnosing amblyopia M. Dariez recommends the employment of feeble currents of electricity. The healthy eye as a rule responds by a luminous sensation to an interrupted current, the strength of which does not exceed one-tenth of a mille-ampère. In atrophy of the optic nerve resulting from primary sclerosis or concomitant with medullary sclerosis, in cases of atrophy from neuritis, embolism, hæmorrhage, or glaucoma, in fact in all those cases in which the forecast is bad, the electric phosphene can only be produced by currents amounting to 5, 10, 50, or 100 tenths of a mille-ampère. On the contrary, in toxic forms of amblyopia, such as those resulting from tobacco and alcohol, the reaction is normal, as it is also in cases of congenital and hysterical amblyopia.

HENRY POWER.

VISUAL ACUITY.—It is of the utmost importance, in order to estimate the degree of functional perfection of the eye, as well as to ascertain from time to time the result of our treatment or surgical interference in any case, to have some means of testing and recording the acuity of vision, which shall furnish us with results both accurate and capable of comparison *inter se*. For-

tunately we do possess such means, and so simple and easily applied are they that the habit of neglecting them and contenting oneself with the more or less vague statements of patients as to improvement or deterioration in their sight is little short of unpardonable. In testing the sight it is not sufficient to note the size of print which the individual is able to read, as a little experience will soon convince one that even the smallest print can be read by persons possessing very different degrees of acuity of vision. The proper test is made at a distance, and rests on a scientific basis which will be shortly explained.

The individual to be tested is placed at the distance of six mètres, or twenty feet, from a board on which are printed seven rows of letters, the so-called Snellen's test types, each row except the top containing different letters of the same size, but the size of the letters becoming smaller and smaller in each successive row. The top letter is of a size capable of being distinguished at the distance of sixty mètres, or 200 feet, whilst the distances at which the letters of the 2nd, 3rd, 4th, 5th, 6th, and 7th rows might be made out are 36, 24, 18, 12, 9, and 6 mètres, or 100, 70, 50, 40, 30, and 20 feet respectively, according as the boards have been constructed for metrical or ordinary notation. It is clear that anyone placed at six mètres from the board, and only being able to distinguish the top letter, might have the acuity of his vision expressed by the fraction $\frac{6}{60}$ or $\frac{20}{200}$, inasmuch as an object, the shape of which can be made out at 60 mètres with the normal eye, can only be seen by him at 6 mètres. There is an advantage in retaining the fraction in this form, and this is almost always done, instead of reducing it to the simpler form $\frac{1}{10}$, as the numerator gives the distance at which the individual tested is placed from the board, and the denominator indicates, by the distance at which it should be visible, the line he sees. If he does not even see the top line at six mètres, he may be approached to the board until he sees it, then if he sees it first at four mètres, his vision is $\frac{4}{60}$. On the other hand, though he is unable to see the second line at six mètres, he might still see the first at seven or eight mètres, corresponding to a degree of visual acuity equal to $\frac{7}{60}$ or $\frac{8}{60}$. It is not, as a rule, convenient or even possible, however, to make examinations at so great a distance, so that it is customary rather, under such circumstances, to test the distance at which the second line is seen instead, in the case in point, say, at four or five mètres, giving a fraction for the acuity expressed nearly by $\frac{4}{36}$ or $\frac{5}{36}$. The acuity of vision corresponding to seeing 2nd, 3rd, 4th, 5th, 6th, or 7th line and no more is, adopting the same notation, $\frac{6}{36}$, $\frac{6}{24}$, $\frac{6}{18}$, $\frac{6}{12}$, $\frac{6}{9}$ and $\frac{6}{6}$. The last, or $\frac{6}{6}$, i.e. when all the letters in the last line can be made out at six mètres, indicates the possession of normal or full visual acuity.

In the same way, as already explained, we may obtain intermediate fractions, though it is seldom that a greater degree of accuracy is desirable, and indeed it should not be aimed at except in cases where we are certain that the circumstances are always exactly similar during the period of examination. Thus we should have to know that the illumination was the same, and that the individual tested was not influenced in his answers by practice and having previously known the letters, as might be the case after repeated examination, or when one eye was considerably better than the other.

In cases where the vision is extremely bad, the test types become inapplicable, and it is usual then to find the distance at which the patient can count the oustretched fingers against a dark ground, noting the result in the following way: V = fingers at 1 foot, 2 feet or more, as the case may be. The vision may be so bad as to render the patient incapable of counting fingers even close up to his eye; still he may have sufficient vision to see the movements of the hand, up and down and from side to side—a degree of vision which may be expressed by noting V = Hand movements close, at 1 ft., 2 ft., &c., according to the distance. When there is not even perception of light we have V = 0.

Let us now consider what we mean by visual acuity, and what are the natural limits to it. It is a very popular belief that if we see objects at a great distance we must necessarily have good sight, but this is by no means the case, as an object may be seen at practically almost an infinite distance provided it be sufficiently luminous, yet we may be very far from being able to make out any detail in it. The visual acuity is scientifically determined by the smallest visual angle under which two or more objects, if presenting sufficient contrast to the intervening space, can be made out as separate, discrete objects. If a straight line be drawn from any point in an object to the first nodal point of the eye (towards the back of the lens), the position of the image of that point on the retina is given by drawing a line parallel to the first from the second nodal point to where it meets

the retina. The two lines determining the positions of the images of two points will accordingly necessarily form an angle between them, the apex of which angle lies at the second nodal point. It is this angle which is called the *visual angle*, and it evidently equals the angle formed by the two lines drawn from the separate points to the first nodal point, or, what comes to the same thing practically, when considerable distances are involved, the angle formed by the lines passing from the two points to the centre of the cornea.

Knowing, then, the distance from the eye of two points, and their distance apart (or more correctly the component of that distance at right angles to the former line), it is an easy matter to determine the visual angle under which they are seen. Thus, if for instance we take a series of black and white squares of equal size, we shall be able, under suitable conditions, to determine the acuity of vision (expressed as a definite visual angle) by noting the greatest distance at which they may still be seen as separate squares, and are not blurred into a more or less homogeneous shaded surface, the details of which cannot be distinguished. Experiments have shown that with normal visual acuity the smallest visual angle may be taken at not much less than 1 minute. The calculated size of the retinal image corresponding to this angle (which again varies according to the position of the second nodal point relatively to the retina) agrees sufficiently closely with the distance between the centres of two contiguous percipient elements of the retina. It is thus probable that a limit is given to the possible acuity of vision by the anatomical structure of the retina, and that the theory is correct which infers that, in order that two objects may be seen separately, the size of the image of the intervening space must at least be so great as to equal the distance between the centres of two contiguous cones, so that it may be possible for one cone at least to receive a different impression from those around it.

The test types above described, and which are those in general use, are based on the assumption that the normal eye is capable of distinguishing objects having an angular separation of 1 minute; thus the black and white portions of the letters in the last line are separated by intervals which subtend angles of 1 minute to the eye at a distance of six mètres (the height of the letters subtending angles of 5′–50), so that when they are seen at six mètres the visual acuity (V) $= \frac{6}{6}$ or 1. The same angles are subtended by the other lines at the distances 9, 12, 18, 24, 36 and 60 mètres respectively. It has been found that the assumption of 1 minute as the size of the visual angle corresponding to full visual acuity makes it rather too small than too big; this is more than counterbalanced in practice when alphabetical letters constructed on this basis are employed, owing to the large angle subtended by the letters as a whole, as well as to the elaboration of an imperfect image arrived at by education and practice. Thus we find that the corresponding more regular figures which constitute the illiterate test type of Snellen cannot be deciphered at the same distance as the letters, and that children or individuals who have only just learnt to read, exhibit more difficulty in making out the letters than others who have learnt to make the most of their retinal images. The visual acuity depends on the optical perfection of the eye, the total as well as relative illumination of the objects to be seen, and the degree of functional perfection of the retina and nerve-centres connected with vision.

G. A. Berry.

VITILIGO. *See* Leucoderma.

VITREOUS, Diseases of the.—The vitreous may be altered by inflammation, by invasion of its substance from without, or by degenerative changes.

Acute hyalitis is not infrequently of a suppurative character. The changes may be very rapid and severe, implicating also the optic disc, retina, and uveal tract. This suppurative panophthalmitis may be secondary to a general pyæmic condition—e.g. after severe wounds of distant parts—or it may arise from purulent uveitis, the result of similar local causes. Its symptoms are congestion of the globe, loss of vision, yellowish-white turbid opacity in the vitreous chamber, dulness of aqueous humour and iris, and chemosis. The globe becomes proptosed and loses its mobility, and a thin purulent discharge escapes from beneath the swollen upper lid. Corneal perforation or, more commonly, shrinking of the globe without perforation is the ultimate result. The active symptoms are associated with marked general febrile disturbance.

But a suppurative hyalitis may run its course with little visible implication of any other structure than the vitreous itself. In such cases the condition may be indicated simply by ciliary congestion, loss of sight, opacity behind the lens, and, ultimately,

retraction of the peripheral part of the iris, with slight softening and gradual shrinking of the globe.

Such inflammations may be the result of wounds implicating the vitreous itself rather than the uveal tract, or consecutive to or concomitant with some forms of meningitis in children. Of this last nature are the greater part of the cases now absurdly designated as *pseudo-glioma*. Their diagnosis from true retinal glioma depends upon the history, the absence of hæmorrhagic spots or blood-vessels from the opaque surface behind the clear lens, the gradual retraction of the iris-periphery, and the development of diminished tension. But suppuration may be localised so as to constitute a true abscess of the vitreous.

Non-suppurative hyalitis may be the result of wounds; of various inflammations of the iris, ciliary body, and choroid, especially those exciting sympathetic disease; or aroused sympathetically. It is also associated with retinitis as a frequent late lesion of secondary syphilis. It is found also in glaucoma and myopia, and is the usual result of the presence of cysticerci, blood-extravasations, and other foreign bodies. The condition is indicated by the presence of local films or haze, or of universally-distributed fine, dust-like opacities. Unless the opaque particles are so far forward and so large as to be visible by oblique illumination, we shall find the ophthalmoscopic mirror, held at perhaps a foot's distance, to be the best means for their individual recognition. A plane mirror has often a distinct advantage over the usual concave one. In many cases, however, the optic disc simply looks reddish, like the sun seen through a mist, and the fundus reflex generally somewhat obscured. The disease may result in the restitution of the normal condition, in the formation of opaque shreds or films, or in the shrinking and condensation of the vitreous. In severe cases, the retina, choroid, and sclerotic will follow the shrinking vitreous till the eye is reduced to a small, deeply-grooved stump. If, however, the ciliary body has been little involved, the globe may preserve its proper size and shape notwithstanding the detachment caused by the general or partial inflammatory adhesion of the retina to the shrinking vitreous. More rarely, the retina is left *in situ* (detachment of the vitreous), separated by serous fluid from the vitreous, which forms either a translucent, filmy, well-defined hemisphere on the posterior surface of the lens and ciliary processes, or a convolvulus-shaped detachment from the retention of its connection with the optic disc. A localised, traumatic, non-suppurative hyalitis may simply encapsule a foreign body, or form a band marking the track of a penetrating wound. Detachments of the vitreous are common after operations attended by loss of vitreous, and are consistent with a fair degree of sight.

It is only in the acute cases of glaucoma that hyalitis can be diagnosed by rapidly-occurring vitreous haze. Pathological examinations of advanced cases always show the vitreous firm and containing an excess of cells, especially those of the spindle and stellate variety. The central canal—the canal of Cloquet—is widely dilated, and the vitreous, as a comparatively thin layer, lines the internal retinal surface. Consequently, retinal detachment is of rare occurrence in this disease.

Vitreous opacities are extremely common in high degrees of myopia, and take the form of freely floating films or veils. They are probably the result of a low inflammatory condition, with subsequent shrinking and condensation of the vitreous. This may be partial or entire, in which case the shrunken vitreous is only represented by a much-folded convolvulus-shaped membrane, which, retaining its attachments at the disc, and at and in front of the ora serrata, floats freely on any sudden movement of the eye between the much-increased fluid of the subhyaloid space and that of the canal of Cloquet. From the want of proper support, detachment of the retina and trembling of the iris are easily brought about. Finer vitreous opacities—for the most part invisible by the ophthalmoscope—the result of very slight inflammation, are also much complained of by myopic patients. The opacities of syphilitic hyalitis present at first a fine dust-like appearance. They may entirely disappear, or floating opacities like those described in extreme myopia may be formed. The retina is also involved in this condition, so that the disease is really a retino-hyalitis.

Cysticercus in the vitreous is very rare in this country as compared with Germany. The cyst is of rounded form, with bluish-grey surface and white shining margin. The hyalitis aroused by it may be slight; but irido-choroiditis and shrinking of the globe are the more common result.

Penetrating foreign bodies, such as fragments of metal and gun-cap, if they do not cause speedy suppurative panophthalmitis, usually result in the same manner.

Hæmorrhages into the vitreous may depend upon some constitutional condition,

such as gout, hæmophilia, or anæmia; but they sometimes occur, especially in young adults, without obvious cause. One eye alone is frequently affected, and relapses are not uncommon. Minute hæmorrhages are sometimes found in severe glaucoma, and depend on disease of the vascular walls. The opacity resulting from blood-infiltrations is greater than can be caused by the amount of blood present, and is due to a secondary hyalitis. The result is, usually, the formation of opaque films or of freely floating shreds, as has been described in myopia. Similar appearances are common after retinal detachments from blows, and are probably there also of hæmorrhagic origin.

Tubercle or *glioma* cells may infiltrate the vitreous, extending loosely from the adjacent affected retina or uveal tract. It is even supposed that tubercle may develop primarily within the vitreous.

Persistent hyaloid artery is rare. It is seen as a greyish cord extending along the canal of Cloquet, from the disc to the back of the lens-capsule.

Muscæ volitantes are only subjectively observed by the patient, and trouble him more or less according to the sensitiveness of his retina. They continue their movement after the eye has been brought suddenly to rest, and thus can be diagnosed from the fixed opacities, which may be of serious moment. Against a white surface, they present to him the appearance of fine filaments which are variously twisted and beaded. They are supposed to be due to minute opacities, which normally exist within the substance of the vitreous.

Fluid degeneration of the vitreous (synchysis) occasionally occurs as a senile change. It is indicated ophthalmoscopically by the free mobility of fine suspended particles, and also by tremulousness of the iris (iridodonesis). The floating particles may appear very bright and glistening (sparkling synchysis). They are made of cholesterine crystals, in occasional association with tyrosine and phosphates.

The *pathology* of hyalitis has been much discussed. The increased corpuscular elements, which at its onset give increased firmness to the vitreous, must be derived either from immigration from the neighbouring blood-vessels, or from a multiplication of the rarely-occurring corpuscular elements of the vitreous itself. These are either small (diam. = ·009) and rounded, with comparatively large nuclei, or similar in body to these but tailed, or much larger (diam. = ·024), well-defined and vesicular, with lateral nucleus. The first-described is probably the form from which the others are derived, and is most abundant in the peripheral parts of the vitreous. Immigration must be the main factor in metastatic suppuration and in the rapidly-developing cases of suppurative panophthalmitis from local injuries. But slight local abscess of the vitreous, or non-suppurative hyalitis developing round a foreign body, is far more likely to be due to a direct cell-proliferation, since the surrounding vitreous has occasionally been observed to remain clear during the development of such local processes. Moreover, in the earlier stages of suppuration of the entire vitreous, we find the opacity not universally distributed but collected mainly into two areas, one covering the ciliary body and in less degree the optic disc and retina, and the other occupying the vitreous centre. The last is mainly constituted by large granular cells of faint outline and faint feebly-staining nucleus, each very like in many respects to the larger cells of the normal vitreous; whereas the former contains, together with a few of these, many smaller multinucleated corpuscles. The larger cells of the centre are probably, like those of local abscesses, derived from a proliferation of the smaller vitreous corpuscles, whereas the cells of the periphery are derived mainly from the neighbouring blood-vessels, to whose colourless corpuscles, as seen within their lumen, they present a very close resemblance. But the multinucleated corpuscles, whencesoever derived, are certainly in a state of very rapid proliferation. In non-suppurative hyalitis many-tailed cells are ultimately developed, by the contraction of which the condensed filmy vitreous occupies less space. Such cells are most abundant near the ciliary body, where they may often be seen to extend from between the elements of the pars ciliaris retinæ. Or, if similarly connected with the retina, they will by their contraction detach this membrane. Otherwise, the vitreous may leave the retina *in situ*, and form a well-defined translucent hemisphere on the posterior surface of the lens and ciliary body, or a convolvulus-like detachment.

Treatment.— When suppuration appears to be threatened, we shall find local warmth, together with the internal use of quinine and stimulants, to be the best means at our disposal. If foreign bodies are the cause, their removal, either by the magnet or otherwise, should be attempted. Failing the accomplishment of this, we should proceed at once to the enucleation of the globe. The symptoms of fully de-

veloped suppurative panophthalmitis are only relieved by time or by the enucleation of the globe. Cysticercus may, in rare cases, be successfully removed by operation. The hyalitis of myopia demands rest, the use of tinted lenses of proper strength, and local blood-letting. That of syphilis is most effectually treated by mercury. If circumstances will not allow of the sufficiently free and long-continued administration of this drug by the mouth, we shall do well to give daily vapour-baths of calomel (gr. x.). Or perchloride of mercury in aqueous solution (1–60) should be daily injected into the muscles, in doses of from 2 to 6 minims. Vitreous hæmorrhages, supposed to be dependent on gout, will be best treated by the regimen and drugs appropriate to this disease. Those due to anæmia will be favourably influenced by the administration of iron and of arsenic. In any case the bowels should be carefully regulated. Hot foot-baths may be also of use in recent cases. Nitrate of pilocarpine has been vaunted as a means of removing vitreous opacities. It should be given subcutaneously in daily diaphoretic doses (gr. $\frac{1}{6}$). But the writer's experience has not confirmed the statements as to its value. The constant electrical current may daily be used for ten minutes, in strength just sufficient for the patient to appreciate a flash when the current is made or broken. One pole should be placed on the nape of the neck and the other over the closed lids. Some, however, prefer the interrupted current. Muscæ volitantes and persistent hyaloid artery admit of no treatment.

W. A. Brailey.

VOMITING as a Symptom in Injuries and Surgical Diseases.—In the following injuries vomiting as a symptom is of importance :—

(1) Head-Injuries. — Concussion is commonly followed by vomiting, even in slight cases. The symptom comes on at the commencement or during the period of reaction, and is favourable. Care should be taken to turn the patient's head well on one side. In slight cases of concussion, the patient does not usually vomit more than once or twice. More persistent vomiting, without corresponding reaction, points rather to contusion or laceration of the brain. In some cases of head-injury, with but slight cerebral symptoms, the vomiting is oft-repeated ; in such cases it is probable that the vomiting centre in the medulla has suffered injury or disturbance. *See* Head-Injuries.

(2) Spinal Injuries.—Injuries to the cervical, more rarely to the upper dorsal spine, are occasionally followed by persistent vomiting. Mr. Erichsen records a case in which, after a blow on the cervical spine, vomiting persisted daily for many months. Usually, the symptom occurs soon after the injury. In head and spinal injuries the vomiting is attended with little or no retching or distress, and it does not become stercoraceous ; the tongue remains clean, and the breath pure. One-grain doses of calomel, frequently repeated, will often relieve the symptom. *See* Back and Spine, Injuries of the.

(3) Abdominal Injuries.—These are all likely to be followed by vomiting, which is indeed a most constant, though not an invariable, symptom. When the rupture is high up the vomit is usually bloody. It is persistent, attended with severe pain, great collapse, and commonly occurs early, while the retching is constant. In a case, however, of ruptured duodenum under the writer's care, in which the patient walked into the hospital and thought he was scarcely injured, the vomiting did not commence for some hours and was very slight. As a rule, however, the nearer the injury is to the stomach the earlier does the vomiting begin. *See* Abdomen, Injuries of the.

(4) Surgical Diseases.—In all cases of intestinal obstruction, vomiting is a most important symptom. In acute obstruction, arising from volvulus, intussusception, &c., it commences early, persists, is associated with great pain, and rapidly becomes stercoraceous. At first the vomit is green and watery, then contains much mucus ; soon it becomes darker in colour, and then acquires the characteristic odour. The time that elapses before the vomit becomes stercoraceous affords no reliable test as to the situation of the obstruction. The vomit, though spoken of as fæculent, is not actually so. The theory of ' inverted peristaltic action of the intestines ' is now, the writer believes, abandoned, and the vomiting ascribed to nervous influence. *See* Intestinal Obstruction.

Acute strangulation or internal hernia not involving the intestine will give rise to vomiting of the same description, for vomiting will occur when any of the abdominal contents are strangulated—e.g. a portion of omentum or of the bladder, &c. Often, in the former case, the omentum seems to constitute the sole contents of a hernia, but includes and is wrapped over a loop of gut, forming an ' omental sac.' So,

too, when an empty hernial sac is inflamed, in acute orchitis of a retained testis, &c.; in fact, when the lesion affects any part supplied by the abdominal sympathetic nerves.

The symptom, if persistent, is the most important indication for operation; if allowed to go on too long, it will not cease after relief of the obstruction by operation. In external strangulated hernia the symptoms, as regards vomiting, are the same as in the preceding cases. In rare cases of strangulated hernia vomiting is a late symptom, but in such there will be a feeling of nausea and a tendency to retch. The more acute the strangulation the earlier will the vomiting commence; but it often happens, particularly in old herniæ, that the patient vomits once almost immediately after the descent of the hernia, especially when, as too often happens, some purgative medicine has been taken. The hernia may still, though irreducible, not be strangulated. Bearing this in mind, it may be laid down as a rule in cases of strangulated hernia, that the occurrence of decided vomiting, if repeated on more than three occasions, demands gentle taxis under anæsthesia, and if this fails, operation. More lives would be saved if the greater gravity of the operation did not too often deter the surgeon from adopting the same rules of treatment in acute internal obstruction. Persistent vomiting after operation for obstruction is the most grave symptom that can occur. *See* Hernia, Strangulated.

In the rare form of hernia known as Littre's, or partial enterocele, the vomiting is less persistent, and not stercoraceous; but in these cases no complete obstruction exists, as is constantly shown by the passage of fæces.

In chronic intestinal diseases vomiting marks the completion of obstruction. It is rare consequently in malignant disease of the intestines.

It not infrequently happens that, after operation for strangulated umbilical hernia, the division of the stricture is almost immediately followed by profuse vomiting attended with scarcely any contraction of the abdominal muscles. It will occur when the stomach or upper part of small intestine is involved. This passive kind of vomiting occurs when the stomach is full of unabsorbed fluid, and is the gravest possible symptom. Vomiting occurs early in all forms of acute peritonitis. The pain is often intense in these cases, but the vomit does not tend to become fæculent. In profound shock, after grave operations, vomiting occurs often in a severe and constant form. Here nutrient and stimulant enemata are demanded. C. T. Dent.

VULVA, Affections of the.—The *vulva*, or external genital apparatus in the female, comprises the following parts:—In front is situated the eminence known as the *mons pubis*, whence on either side extend backwards the *labia majora*, which limit the genital fissure behind by their union in a thin fold of mucous membrane, the *fourchette*, at the anterior border of the perineum. From the *clitoris*, seated immediately beneath the mons, two diverging folds of mucous membrane enclosing erectile tissue, and known as the *labia minora*, or *nymphæ*, pass backwards to blend with the inner surface of the labia majora. The intervening space, termed the *vestibule*, shows the opening of the urethral canal (*meatus urinarius*) seated in the middle line immediately in front of the vaginal orifice.

I. Malformations, involving more or less complete obliteration of the genital fissure, are always congenital, and constitute one or other of the various forms of the condition usually known as hermaphroditism.

Adhesion of the Nymphæ is a minor malformation occasionally found in young children, either as a congenital condition or as the result of some local inflammatory mischief in early infancy. On separating the labia majora in such cases, the vulvar opening is seen to be partly occluded by a membranous structure connecting the margins of the nymphæ, and continuous posteriorly with the skin of the perineum. The membrane, however, is always deficient anteriorly, where an aperture exists corresponding with the opening of the meatus urinarius; and the introduction of a probe at this point will at once reveal the true nature of the deformity.

Treatment.—The adhesion, as a rule, can be easily torn through by means of a probe, or by forcible separation of the parts; but, if necessary, it can be divided on a director with the knife; the only after-treatment required being the introduction of a strip of oiled lint for a few days, in order to prevent re-union of the torn surfaces.

Hypertrophy of the Clitoris is sometimes seen in infants. Removal by means of the thermo-cautery may be deemed advisable.

Acquired malformations in the adult, as the result of cicatricial contractions after sloughing due to injury, are extremely rare.

II. Surgical Injuries.—*Contused* or *incised wounds* of the labia occur either from intentional violence, as kicks, blows, or stabs; or more commonly as accidental injuries, from falling or sitting upon some pointed or sharp-edged object. The extreme vascularity of the tissues, while always causing free hæmorrhage at the time of the accident, has the advantage of promoting rapid healing.

Treatment.—After careful cleansing, the skin-edges should be accurately adjusted by sutures, and a dry pad of some antiseptic material be applied to the vulva and retained in place by a T-bandage, the patient meantime being confined to bed. Should leucorrheal discharge exist, daily syringing of the vagina with a carbolised lotion will be required in order to avoid any decomposition.

Contusions—due to violence—may lead to considerable swelling and inflammation of the labia, best treated by the early and continuous application of cold compresses.

Hæmatoma, or *thrombus*, are terms applied to a rapidly formed swelling of the labium, caused by a subcutaneous effusion of blood—an accident which is favoured by a varicose condition of the vessels of the part consequent upon intrapelvic pressure. In addition to external violence as an exciting cause of this injury, may be mentioned the pressure of the child's head during parturition, or even the sudden strain of a violent muscular effort—inducing rupture of an over-distended vein. The rapid formation of the swelling, in a patient subject to varix, will at once suggest the true nature of the injury.

Treatment.— Absolute rest, with the continuous application of an ice-bag, will prevent further effusion and favour absorption. For some few days after the accident, the bladder and rectum should be evacuated without the patient's being allowed to strain in any way. If suppuration occur, poulticing, followed by early incision, will be required. This operation should, as far as possible, be performed with all antiseptic precautions, in order to avoid risk of septic absorption, especially when the accident has occurred during parturition.

Lacerated contusions, with free external hæmorrhage from a ruptured varicose vein, may prove rapidly fatal from loss of blood. The patient should at once assume the recumbent position, when firm pressure by means of a pad and a T-bandage will usually control the bleeding.

Fissures about the nymphæ or fourchette, resulting from injuries inflicted during coitus or a first labour, sometimes give rise to much discomfort and pain on exertion, and may even render intercourse unbearable. Complete rest for a few days, combined with the use of boracic acid ointment or of some other mild application, will in most cases readily suffice for their cure, when recent. Failing this, division with a sharp knife, followed by the employment of iodoform powder or ointment, may be required.

III. Inflammation of the Vulva (*Vulvitis*).—1. *In Children.*—Simple catarrhal inflammation of the mucous surfaces occurs in weakly infants from neglect of cleanliness, or from sympathetic irritation due to the presence of thread-worms. The parts are found swollen and tender, and bathed in muco-pus.

Treatment. — Frequent ablution with warm lead lotion, followed by the application of boracic acid ointment, will usually effect a cure, if any co-existing source of irritation be at the same time removed.

Noma is a rare disease met with in unhealthy, ill-fed children during the course of, or as a sequela to, measles, scarlet fever, or typhoid. The affection, which commences by the formation of a small vesicle seated upon an indurated base, leads rapidly to localised gangrene of the part, accompanied by much inflammatory œdema. Constitutional symptoms are always severe, and may readily induce fatal exhaustion.

Treatment.—The constant use of warm charcoal poultices, or of strips of lint soaked in hot boracic lotion and covered with oiled silk, answers best as local treatment. Meanwhile, good nourishment and wine must be freely administered, and the patient's strength maintained by means of a mixture containing ammonia and bark, or chlorate of potash and quinine.

2. *In Adults.—Simple* vulvitis, due to deficient cleanliness, irritating vaginal discharges, skin-affections, or other sources of irritation, is not of very uncommon occurrence, and if neglected may readily become chronic. In the *acute* form, the parts are swollen and tender, the mucous surfaces red and irritable, and coated with muco-purulent discharge. The *chronic* form is always accompanied by much irritation (pruritus); the labia are thickened and indurated, and often the seat of painful fissures.

Treatment during the *acute* stage requires rest in bed, combined with avoidance of all friction between the opposed surfaces, which should be frequently bathed with warm lead lotion and kept covered with

strips of wet lint protected by means of oiled silk. Should abscess of the labium occur, it must be opened by an early incision. When the affection has become *chronic*, any discoverable cause of irritation must be removed, and the parts then kept scrupulously clean and frequently dusted over with oxide of zinc and starch powder.

Specific vulvitis, due to gonorrhœa, does not differ materially from the ordinary acute affection, excepting that it is usually accompanied by some urethritis, and often leads to formation of abscess. The vaginal mucous membrane also is very often acutely inflamed at the same time. For treatment, *see* Vagina, Acute Inflammation of the.

IV. Skin-Affections. — 1. *Eruptions* affecting the vulva — whatever be their nature or origin — invariably give rise to intense irritation (pruritus), relief from which is usually sought in rubbing or scratching. This, in time, leads to abrasions and inflammatory changes, which readily mask the original characters of the eruption, and, in long-standing cases, may induce marked alterations in the appearance of the parts due to thickening and induration of the tissues.

2. *Parasites.*—The presence of the *pediculus pubis* causes a lichenoid eruption chiefly affecting the mons and adjacent parts of the labia majora. The large size and colour of the parasite render its detection an easy matter. Thorough inunction of a mercurial ointment, or frequent ablution with 1–20 carbolic lotion, followed by the application of a vaseline ointment containing one part in ten of carbolic acid, will usually destroy the source of irritation and cure the disease.

The only other parasitic affection here met with is *scabics*, which may cause an impetiginous eruption involving the mons and the neighbouring parts of the abdomen and thighs. The characteristic itching and the existence of the rash elsewhere—about the patient's wrists and fingers — will suggest the nature of the disease, which yields readily to the use of sulphur ointment.

Venereal Warts (*Verrucæ*), are met with on the vulva quite independently of any constitutional taint, but simply as the result of persistent irritation of the mucocutaneous surfaces from neglect of cleanliness. They are thus not uncommonly found coexistent with gonorrhœal discharges. Their most usual seat is on the inner aspect of the labia, where they appear as irregular cauliflower-like growths, often more or less pendulous, and occasionally of considerable size.

Treatment. — When small, they are readily removable with scissors, after which their base should be touched with nitrate of silver. Scrupulous attention to cleanliness, and the use of a dusting powder of oxide of zinc, or calomel and starch, will usually prevent recurrence. If large, the growths should be removed with the help of the thermo-cautery, in order to avoid hæmorrhage.

Chancres occurring upon the female genitals may be either simple (non-infecting) or specific (syphilitic). Their most usual situation is just within the fourchette, or upon the nymphæ; but they may occasionally be seen upon the cervix uteri; and very rarely upon the vaginal mucous membrane. When seated externally, they are sometimes difficult of detection, owing to the inflammatory œdema caused by the irritation due to their presence.

The *simple non-infecting* chancre is the form most commonly met with, occurring usually as multiple sores of a circular shape with sharply-cut but shallow edges, and often accompanied by much swelling and tenderness of the parts.

Treatment.—A crystalline powder of iodoform, dusted upon the sores twice daily, will rapidly modify their character and promote their healing. All friction between the opposed surfaces of the labia must, meantime, be avoided by the interposition of strips of lint spread with boracic acid or some other antiseptic ointment, and whenever possible the patient should be confined to bed. If thought desirable to at once destroy the special virus of the sores, this may be effected by the application of fuming nitric acid, while the patient is anæsthetised; on the separation of the resulting slough, a healthy surface is left, which will heal readily if perfect cleanliness be ensured with avoidance of friction.

The *specific* or *syphilitic* chancre occurring on the mucous surfaces of the female genitals rarely presents the characteristic induration of the true Hunterian sore, owing to the constant moisture of the part. When seated upon the mons or the outer aspect of the labia, it will, however, possess the ordinary features of a hard chancre. In any given case, the presence of a single sore, apart from its special character, which may be masked by its situation and by the degree of irritation to which it has been exposed, will point to the probability of a specific origin.

Treatment.—Beyond strict attention to cleanliness, and the subdual of inflammation by appropriate means, the local treatment consists in the use of black wash, or of calomel and starch powder as a dry application. For the constitutional management of the patient, *see* Syphilis.

Mucous Tubercles are met with as a local secondary manifestation of constitutional syphilis, which fact in relation to their origin constitutes an important distinction between them and the ordinary venereal warts. They consist of flat, broad-based, slightly elevated patches of soft papillary growth, usually seated upon the inner surface of the labia, where they readily spread by contact. The discharge due to their presence is extremely contagious.

Treatment.— Frequent ablutions, followed by the use of a calomel and starch dusting powder will answer best in the way of local treatment, which must be supplemented by constitutional remedies.

V. Tumours.—*Hypertrophy.*—A simple variety of this deformity is occasionally seen affecting the labia minora, which may become so thickened and pendulous as to cause serious inconvenience, and thus require removal. Another form of enlargement, often traceable to syphilis, and resembling in a minor degree the condition known as elephantiasis in tropical countries, is sometimes met with involving the labia majora, and thence extending forwards over the mons and backwards over the skin of the perineum. The clitoris is also occasionally the seat of this disease. The growth, which consists in a thickening of the layers of the true skin, combined with increased formation of connective tissue and dilatation of the lymphatic spaces and ducts, presents on the surface a hard, irregular, tuberculated appearance. When of long standing, it may constitute a mass of considerable size, causing much discomfort by its weight and bulk. Excision with the cautery knife is the proper treatment for all such growths.

Fibromata, identical in structure with the same formations as met with in the uterine walls, sometimes develop in the labia majora. Their tendency is to become pedunculate, when their removal is a matter of no difficulty.

Lipomata, originating in the adipose tissue of the mons or of the labia, are of rare occurrence. When large they may require to be excised.

Cysts, due to distension of the vulvo-vaginal glands, as the result of inflammatory occlusion of the mouth of the duct, are not infrequently seen. They give rise to an oval-shaped or somewhat lobulated swelling at the lower part of the labium, tense and elastic to the touch, and not tender unless inflamed. The retained secretion consists of a clear glairy fluid, occasionally of a brownish hue.

The only *symptom* usually complained of is discomfort felt in walking; but, should the cyst inflame and suppurate, it will give rise to all the signs of an acute abscess.

Treatment consists in complete evacuation of the cyst, and subsequent destruction of its secreting surface. This may be effected, after free incision practised on the inner aspect of the labium, by seizing the base of the cyst with a tenaculum and everting as much as possible of its wall, which is then excised with scissors. Another plan consists in freely destroying the lining membrane by means of the thermo-cautery. In either case, the cavity should be afterwards plugged with carbolised lint or iodoform gauze, and allowed to close by granulation.

Pudendal hernia, corresponding with scrotal hernia in the male, may result from a congenital patency of the process of peritoneum, which to a greater or less extent invests the round ligament in its passage from the external abdominal ring to be inserted into the dartoid tissue of the labium. The possibility of such a condition, although a very rare one, should always be borne in mind when examining any tumour of the labium. The presence of the prolapsed gut, apart from the occurrence of any strangulation, which is extremely uncommon in this situation, usually gives rise to a sense of discomfort sufficient to draw attention to the part. Impulse on coughing, with resonance on percussion, combined with the possibility of reduction by taxis and position, will serve to reveal the true nature of the swelling. The hernia should be supported by means of a well-fitting truss; or, if desirable, a radical cure may be attempted.

Hydrocele of the canal of Nuck is an extremely rare condition, due to a sacculated collection of fluid in the unobliterated portion of the process of peritoneum above alluded to. The irreducibility of the swelling and the absence of resonance and impulse would serve to distinguish it from intestinal prolapse; while puncture with the needle of a hypodermic syringe would settle the diagnosis. Aspiration of the fluid followed by injection of tincture of iodine as in the case of an ordinary hydrocele, constitutes the most effectual treatment.

VI. New Growths.—*Malignant disease* of the vulva, usually of an epitheliomatous type, is not very uncommon, although much less frequently seen than cancer of the cervix uteri. The affection, which may originate in any part of the cutaneous or mucous surfaces, usually commences in the immediate neighbourhood of the clitoris as a small nodular growth, which in time ulcerates and gives rise to a sore with raised and indurated margins, showing no tendency to heal. Progress at first is slow and painless, but, as the ulceration extends, severe attacks of hæmorrhage occur, and rapidly reduce the patient's strength. As a rule the inguinal glands soon become involved.

Treatment. — Complete extirpation of the diseased tissues at an early stage of the affection, before the occurrence of secondary deposits, offers the only chance of relief. This may be effected by means of the knife or scissors, followed by the application of the thermo-cautery for the arrest of hæmorrhage.

Vascular growth of the meatus urinarius—*urethral caruncle*—is a somewhat common affection in middle-aged women, often productive of great discomfort. It may be described as a species of angeioma developed from the mucous membrane at the entrance of the urethral canal, where it appears as a vascular excrescence of a bright red colour, bleeding readily when touched, and usually extremely sensitive, often to such a degree as to give rise to exquisite agony on micturition or during coitus. The only effectual treatment consists in destroying the growth with the thermo-cautery, while the patient is under the influence of an anæsthetic.

W. A. Meredith.

W

WARDROP'S OPERATION FOR ANEURISM. *See* Aneurism.

WARTS (*Synon.* Verrucæ).—Warts are small growths mainly consisting of hypertrophied papillæ of the skin.

Several distinct growths besides the true wart (Verruca vulgaris) are included under the general term 'warts.' Tyloma is sometimes regarded as a warty growth, but it differs altogether from warts in structure, being simply a hypertrophic growth of epidermic structures without hypertrophy of the papillary layer of the skin.

Warts are of two kinds—*Acquired warts* and *Congenital warts.*

Acquired warts are met with in two varieties—(1) Verruca vulgaris; (2) Verruca senilis.

Verruca Vulgaris. — Common warts first appear under the cuticle as smooth, slightly raised, little tumours; as, however, they increase in size and prominence, the smooth epidermic covering is lost, and then the top of the wart presents a rough granular or filiform surface, which is due to the exposure of the enlarged papillæ. Warts may appear on any part of the body, but they are most common on the hands in children, and on the scalp in adults. Sometimes they appear in great numbers, so as to constitute a veritable eruption. The writer has met with several instances in which the face of a patient has been completely covered with small, discrete, warty growths.

Verruca senilis differs from the common wart in being softer and more flat. Warts of this kind usually occur in great numbers, especially on the backs of old people. They are of a greasy character, and generally of a darker colour than the surrounding skin. They are essentially a senile change.

Verruca acrochordon, *see* Acrochordon.

Congenital warts are not very common. They do not generally take the rounded shape of common warts, but form groups which are irregular both in size and distribution. They are really a kind of malformation of a limited portion of the skin, in which there is a permanent hypertrophy of the papillæ. Congenital warty growths generally assume a dark appearance, and, when they form considerable and elongated patches, they constitute the Ichthyosis hystrix of writers; it is, however, an error to regard these warty patches as any form of ichthyosis, which is essentially a *symmetrical* disease, involving changes in the skin of a different kind altogether. Congenital warty growths are always unsymmetrical in distribution, are wart-like in structure, and are surrounded by perfectly healthy skin; in these respects they contrast remarkably with ichthyosis. The term Ichthyosis hystrix has been mis-

applied, and should now be dropped out of our nomenclature. *See* Ichthyosis.

Treatment.—Soft warts are easily cured by painting them daily with a saturated solution of salicylic acid in flexible collodion. The best caustic for hard warts is a saturated solution of potassa fusa in water.

R. Liveing.

WASHING OUT THE BLADDER. *See* Prostatic Hypertrophy.

WATSON'S PLASTER OF PARIS SWING SPLINT for excision of the knee consists of two parts:—(1) A wooden back splint cut away freely opposite the knee, so that the leg and thigh pieces are only connected by a narrow bridge behind the ham; (2) a suspension rod, made of telegraph wire or hoop iron, reaching from the toes to the groin, and across the knee in the form of a bracket. The limb is enveloped in cotton-wool and placed on the back splint, to which it is fixed by plaster of Paris bandages. The suspension rod is next placed in position along the front of the limb, and fixed by the final layers of the bandage. The splint is suspended to a cross-bar placed over the bed.

WEBBED FINGERS. — The digits may be united by coalescence of the bones (*see* Fingers, Congenital Deformities of the), but a more common deformity is that known as web-fingers, in which the digits are united throughout the whole or part of their length by a prolongation of skin, similar in nature to that which normally intervenes between their bases. Sometimes the union is more intimate and formed by a closer union of the deeper tissues, when no separation is possible; but, with the more usual web, a certain amount of lateral movement and therefore of usefulness is attainable. The deformity is less often symmetrical than not.

Treatment.—Where a true web exists, it is desirable to effect an artificial separation, especially of the thumb from the index, and of the little finger from its neighbour, and of the other fingers in order of their relative importance. Many devices have been adopted for this purpose. The main principle should be to avoid cicatrisation as far as possible; and this is best effected by making a dorsal and a palmar flap, the one to be applied to the outer edge of one finger, and the latter to the inner edge of its fellow. When the union involves the deeper structures, more harm than good will come of interference, though success has in a measure been obtained by engrafting skin from the haunch and other parts.

As opposed to the condition above described, the clefts between the fingers are sometimes found to extend for an unnatural distance into the palm, and even up to the carpus. As a general rule such conditions interfere but slightly with the usefulness of the member, and surgical interference is more likely to do harm than good.

John H. Morgan.

WHITEHEAD'S OPERATION. *See* Tongue, Operations for Removal of the.

WHITLOW, or PARONYCHIA, is a generic name for an acute inflammatory affection of a finger, which is often extremely painful, and may lead to very serious consequences. The varieties of the disease are easily classified according to the tissue in which the inflammation commences, and the symptoms and consequences of these varieties are different in degree and in importance.

1. Acute inflammation of the skin (paronychia ungualis). This is by far the least serious form, and is seen most frequently in children as the result of some unhealthy condition of the blood.

Symptoms.— The pulp of the ungual phalanx becomes swollen, and is slightly painful; it is at first red, and afterwards hot and throbbing. On the third or fourth day a bulla appears containing serum, which becomes mixed with pus, and often with blood. There is not much constitutional disturbance, but as the condition of one finger improves, others, on the same or on the opposite hand, become similarly affected. The bulla breaks, and, its contents becoming discharged, the surface beneath is raw and tender, but soon is covered with healthy epidermis.

Treatment.—The state of the tongue and of the bowels should be corrected by a slight mercurial purgative, and some tonic in the form of bark, quinine, or iron given internally. The fingers must be frequently bathed with warm water, and some boracic ointment on lint is to be applied, covered with cotton-wool to promote warmth and to prevent injury.

2. A more painful variety of whitlow is that in which the inflammation attacks the areolar tissue of the last phalanx. This usually results from the introduction of septic matter through some slight scratch or crack in the skin, although this cannot always be detected. The end of the finger becomes tense both on the palmar and

dorsal surfaces, and is extremely painful, with throbbing in the part. The inflammation may spread up the finger and into the hand, or there may be lymphangitis with swelling of the lymphatic glands. As a rule, however, the inflammation is confined to the structures of the last phalanx, all of which may become implicated. From the fact that the long flexor tendon has in this situation no prolongation of its sheath, the tendon at its insertion frequently becomes involved, especially if proper treatment is delayed, and the tendon eventually will come away as a slough, and necrosis of the phalanx will often follow. The amount of pus is small in proportion to the pain or to the constitutional disturbance.

Treatment should consist of making at an early period a deep clean incision along the centre of the palmar surface of the phalanx. This should never be carried to the end of the finger, where the large supply of nerve-ends makes the part exquisitely tender. It is well not to wait for suppuration to occur, and indeed it may often be prevented by early incision. Warm antiseptic lotions should be applied, and the finger should be frequently held in very hot water, and the hand must be raised or carried over the opposite shoulder. If destruction of the tendon or of the bone has taken place, they must be allowed to separate of their own accord.

3. The third form of whitlow has a different seat of origin—viz. the sheath of the flexor tendon. Paronychia tendinosa or thecal abscess commences in the sheath, either spontaneously, or as a result of some slight puncture through which septic matter is introduced.

Symptoms.—At first there is a throbbing, painful swelling on the palmar surface of the middle or proximal phalanx, which gradually extends so that the whole finger is involved, and the tension and swelling gradually spread upwards into the palm, which becomes red, doughy, and distended with pus, and this condition may even extend beneath the annular ligament of the wrist into the forearm. The pain, from the distension of the canal, and the constitutional symptoms soon become severe. If not treated by early incision, the pus is discharged from one or more sinuses at the side of the finger, which are marked by fungous granulations, and through which also the sloughing portions of tendon are discharged; later, the bones and joints become implicated, and in the former sequestra are formed, which remain to be exfoliated. As the matter finds vent the swelling diminishes, but when the tendon has been destroyed the finger becomes contracted, withered, and useless.

4. In the remaining form of whitlow, paronychia osseosa, the inflammation commences in the bone or periosteum, generally of the terminal phalanx; but these parts are more usually involved as a consequence of one of the other varieties of this disease, and in any case the symptoms resemble those of the second variety, except when disease of the bone follows upon crushes or other such injuries, and death of the whole or part of the bone ensues.

Treatment.—In all the three latter forms early incision through the affected part, in the middle line and down to the bone, is the only means of allaying pain and of preventing extension of the disease. After this, the hand should be held in very hot water every two hours, and in the interval should be raised and enveloped in lint steeped in warm boracic lotion. Due time must be allowed for the separation of necrosed parts of tendon or of bone, and, as soon as the inflammation has subsided, frequent passive movements of the joints must be employed. If the destruction has been extensive, amputation of the finger may become necessary. In the constitutional treatment, a free purge should be given early, and bark and ammonia, with stimulants and opium to relieve pain. If matter has collected in the palm, it must be afforded a free and early exit.

JOHN H. MORGAN.

WOOL-SORTERS' DISEASE. *See* MALIGNANT PUSTULE.

WOUNDS, Treatment of.—Recent solutions of continuity in the external soft structures of the body constitute the great majority of wounds; but the term has a much wider application, etiologically, physiologically, and therapeutically. A subcutaneous rupture of the tendo Achillis and a transverse fracture of the tibia, an opening into the knee-joint, and a simple fracture through the femoral condyles, are lesions of unequal seriousness; but they are nevertheless wounds, essentially alike biologically and surgically, repaired by the same process, and amenable to analogous principles of treatment. The parallel is substantially true, however various be the causes producing the solution of continuity; although some wounds—e.g. from gunshot or from the bite of rabid animals—present special therapeutic indications. *See* GUNSHOT WOUNDS; HYDROPHOBIA.

It is to the treatment of wounds strictly so called, and as met with in ordinary surgical practice, that this article is specially devoted.

The typical and most common wound is an incised one, and it may be taken as the basis of the description of wound-treatment generally. The peculiarities of punctured wounds do not materially affect the principles and plan of dressing; but contused and lacerated ones deserve some special notice.

In the case of a slight, clean-cut wound, all that is usually required is to stanch the bleeding by pressure with a dry absorbent material, and keep the edges in close contact. Pressure for a few minutes may suffice to cause adhesion, which at first is a purely mechanical sticking together, rapidly converted into a living bond of union by the process of organisation. A little goldbeater's skin, or brushing the part with collodion, common glue or gum, protects from the air and maintains coaptation. If the wound be a little more extensive, an absorbent pad and bandage, or non-irritating adhesive plaster, may be usefully employed to secure immobility. Additional protection may be given by a splint, which is best prepared of pliant material, so as to admit of being moulded to the part and left to solidify. Such splintage may be made with folds of gummed paper, wire or thin wood, light rough millboard soaked in dextrine or paraffin, absorbent tissue impregnated with paraffin, or plaster of Paris.

In larger lesions, the precept to be observed in the first treatment of all wounds becomes specially important—to search for and remove foreign bodies. As a general rule, too much inquisitiveness is to be discouraged; but if a wound be of considerable depth, it is only by probing it that the presence of foreign bodies can be ascertained. When admissible, the finger is the best searcher; but a porcelain-tipped probe and a magnet have their special uses in detecting metallic bodies. Whatever be the means of exploration, it is scarcely possible to exercise too much gentleness.

Arrest of Hæmorrhage.—One of the first indications in the treatment of wounds is to stop bleeding from divided vessels. In the articles Hæmorrhage, Ligatures, and Torsion, the methods for arresting bleeding in surgical practice generally are fully dealt with; and it will only be necessary here to recapitulate briefly, with special reference to wound-treatment. Too much anxiety about bleeding from small vessels before the edges of a wound are brought together is, as a rule, inadvisable; very frequently it is mischievous. More than a century ago, Mr. Robert Mynors of Birmingham gave this wise counsel:—'We need not be too solicitous about the security of small arteries by ligature; for, if the recently divided soft parts are gently brought together, and nicely retained in contact, if a passive state of the muscles surrounding them is duly attended to, and their own natural contraction properly assisted by the judicious and artful application of a bandage, a perfect security from future hæmorrhage will be insured, as well as the most likely means employed to obtain a speedy and easy cure of the wound by the first intention.' If the oozing be rather more free than can be controlled by mere apposition of divided surfaces, light pressure with a pad or sponge squeezed out in iced water or in very hot water will be found a good hæmostatic. As aids to immobility and pressure in the arrest of hæmorrhage, styptics are valuable, and foremost amongst them may be named the compound tincture of benzoin, collodion, and styptic colloid. If these simple means be not sufficient to check bleeding, acupressure or forcipressure, ligature or torsion must be resorted to, with a tourniquet or Esmarch bandage, according to the circumstances of particular cases; but the beneficial influence of position should never be neglected as a powerful agency in reducing the rate and amount of blood-flow. By raising the hand and bending the elbow at an acute angle, the radial pulse is at once reduced to bare perceptibility. So with the thigh and leg, and the popliteal and tibial arteries; the physical effect being almost as obvious, and for the same reasons, as when an india-rubber pipe connected with a water-tap is raised and bent. Whatever be the chief agency relied upon for arresting bleeding from wounds—be it a ligature, forcipressure, or a styptic—immobility, position, and pressure are powerful contributories; and they are also the most potent factors in maintaining wound-apposition, preventing irritation, and promoting repair.

Wound-Cleansing.—Dirt is foreign material, which it is necessary to remove with care before attempting the apposition of wound-edges. If that can be done without liquid, all the better; but if any fluid be required for cleansing purposes, it is advisable to use equal parts of spirit and water, or a saturated solution of borax with the addition of about one-eighth of its bulk of glycerine. Another good cleansing liquid may be prepared with equal parts of water,

glycerine, and methylated spirit. Mr. Bryant recommends for the same purpose water, to which sufficient tincture of iodine has been added to make it a light sherry colour; and Dr. B. W. Richardson has suggested, with the same object, proof spirit containing tannin and glycerine. In using any of these liquids it is advisable to avoid ordinary sponges—a very common source of contagious poisoning. Camel-hair pencils, pledgets of lint, soft hempen tow, or absorbent gauze and cotton tissue are very good cleansing agents. A still better one is prepared on the writer's suggestion by Messrs. Bourroughs & Wellcome. It is an artificial sponge made up with a combination of elastic and absorbent fibres in an absorbent gauze covering, and enclosing any antiseptic prescribed in a central capsule. This can be preserved any length of time, and the antiseptic set free, by squeezing the capsule to breakage, just before the sponge is required for use. On the same principle, very efficient absorbent and antiseptic pads may be constructed for wound-dressing.

Anæsthetics.—If the patient bear the exploration and cleansing of the wound without much pain (and it is understood that all manipulation is to be most gentle), then the next step in the dressing may be proceeded with. If much pain be unavoidable, an anæsthetic should be administered, for upon the accuracy of every step in the first dressing the healing of a wound largely depends. Nothing is more important than to save pain, which is a cause as well as a sign of physiological disturbance, and a very potent factor in the initiation and development of pathological changes.

Wound - Apposition. — The wound cleansed and the bleeding stanched, its edges have to be adjusted and means provided for keeping them in accurate apposition. This is the time to make provision for drainage. It is important in closing the wound to include within it as little fluid as possible, and for this purpose it is well to exercise equable pressure and to give exit at the dependent angle to fluid as it is exuded. Only experience can teach whether the wound may be completely closed with safety; but, as a rule, direct union may be attempted throughout their whole extent, in wounds of the head and face and upper limbs, for in those parts compression can be effectually exercised, and immobility secured. But when the serous cavities are penetrated, or the large vessels tied, and when the bone is implicated, as in amputation, compound fracture, and excision, the safest course is not to close the fresh wound completely, but to make adequate provision for drainage.

Drainage, as a general rule, should be provided for at the dependent aperture, either by an india-rubber tube, or by a finer drain, such as horsehair, silk, or catgut. These agents may be left of sufficient length externally to perforate the dressings, so that these need not be changed while the liquid is drained outward into a convenient receptacle—a physical process which may be powerfully assisted by position and pressure. One of the chief advantages of absorbent dressings is that, provided the edges of the wound be not hermetically closed through its whole extent, exuded fluid may be taken up without the intervention of a draining conduit.

Sutures.— Metal is the preferable material for sutures; and iron, while very much cheaper, is as good as silver; but catgut, hemp, or silk may also be used. The number of sutures and the depth to which they are inserted must depend upon circumstances. It is of no use bringing together edges and leaving deeper wounded parts asunder; and the combination of deep and superficial sutures is very desirable. Accurate apposition being of the first necessity, as many sutures must be inserted as are necessary to secure it. When adhesive plaster is used, the writer prefers Southall's elemi; but in fresh wounds preference is to be given—as an aid to, or substitute for, sutures—to strips of absorbent gauze or tissue soaked in styptic colloid, tincture of benzoin, or collodion. When the latter agent is employed, allowance must be made for its contraction, which is least in the flexile preparation. While accurate apposition is important, tension must be avoided, because always opposed to wound-healing. *See* Sutures.

Pressure and Immobility.—Pressure is a most beneficial agency in maintaining temporary, and promoting permanent, union of wound-edges. It not only keeps the parts mechanically together and so prevents nerve-tension, but it opposes stasis and effusion, and promotes absorption. Pressure is best exerted by soft absorbent bandages, equably applied without reverses over absorbent tissue or pads, which should be used abundantly, and with all necessary means, such as moulded splints and suspension, for maintaining the nearest possible approach to absolute immobility.

When the dressing is complete, much remains to be done for the patient's comfort to ensure perfect rest. That position of the body is the best which is the easiest,

and limbs require to be fixed or suspended, and the bed to be made or raised, so as to facilitate venous return and favour muscular relaxation. The quieter the part and the patient are kept, the better, in conformity with the truth embodied in John Hunter's generalisation:—'*The first and great requisite for the restoration of injured parts is rest.*'

Infrequent Dressing.—When the first dressing is to be disturbed can only be determined by closely watching constitutional symptoms; taking heed of the patient's feelings, pulse, respiration, and temperature. Infrequency of dressing is most conducive to successful wound-healing. When the first dressing is removed, it is preferable to cut the bandages than to unrol them. If styptic dressings have been employed, they must be softened with ether or common spirit, and the utmost care taken to effect the least possible mechanical disturbance and to cause the minimum of nervous apprehension. Every step of the dressing should be conducted with the utmost lightness and without hurry. What sutures are to be removed, whether drainage-tubes are to be withdrawn or shortened, must be determined by the condition of parts. Applying the same kind of materials as used in the first dressing with equable elastic pressure, attending to physiological position, and securing the nearest possible approach to perfect immobility and painlessness, the treatment of the wound may safely be conducted to complete cicatrisation.

Antiseptics have, so far, only been mentioned incidentally; but the materials recommended for the wound-dressings, such as borax and glycerine, tincture of benzoin, styptic colloid, and collodion, are in an eminent degree antiseptic. So, too, is the action of drainage and of all absorbent dressings, in direct proportion to their power in taking up secretions and leaving the neighbourhood of a wound clean and dry, in a condition as little as possible favourable to putrescence. In so far as rest, position, and pressure prevent irritation, they are opposed to vascular excitement and attendant effusion, which is the material for decomposition. Thus they are in effect antiseptic. The question in wound-treatment is not one of antiseptics or no antiseptics, but of the form and proportion in which they should be employed in particular conditions. The great antiseptic is life. The living tissues have a natural preservative power, which, if guarded and conserved by the surgeon on physiological principles, offers the surest guarantee for healthy repair, which is only an adaptation and extension of normal nutrition. In exceptional cases—e.g. in the wound formed in the opening of a psoas abscess—when perfect drainage and pressure are impracticable, the need for antiseptic applications is exceptionally great. It is under such circumstances that the merit of the Listerian method (*see* Antiseptic Surgery) is best illustrated; but even in many of those *cliniques* in which the carbolic spray found most favour, it has been abandoned; while such recognised principles of wound-dressing as cleanliness, drainage, and immobility, infrequent dressing, position, and pressure, are steadily making way.

Cleanliness, and infrequent dressing which is the corollary of the great principle of absolute rest or immobility, are powerfully aided by the use of *absorbent and dry dressings.*

The healing of wounds, once apposition has been effected, is favoured by dryness, not in the mere literal sense of the term, but as opposed to accumulation of fluid. In general, it may be said that repair and healing, liquefaction and decay of animal structures, proceed together. Healing is rapid in direct ratio to dryness and compactness of tissue; in inverse ratio to effusion and laxity. This is the key to the physico-chemical influence of drainage in favouring wound-healing. The same explanation applies to absorbent dressings, which, by carrying off effused fluids as rapidly as they are poured out, keep the wound clean and dry, and are in direct measure antiseptic. By checking arterial supply, favouring venous return, and preventing extravasation, position and pressure contribute to wound-dryness, and so to wound-healing. By its great affinity for water, glycerine enhances the drying power of absorbent dressings, and its peculiar antiseptic property acts in the same direction. Absorbent, astringent, and antiseptic powders, such as bismuth and iodoform, charcoal, earth, sawdust, and sugar, have a multiple therapeutic action, in which their drying power is one of the principal factors. It is a fact of common knowledge to butchers and housekeepers, that to preserve meat it is essential it should be kept cool and dry,—the freer the current of air around it the better. Any moisture which exudes on the surface from time to time must be wiped off, and the practice of sprinkling with flour or other absorbent material is based on the well-known necessity of keeping the meat dry.

Moistening and putrefaction, drying and preservation, go together. Experience proves that it is along damp courses and alluvial plains that contagia spread, not on sandy hills. So with wounds: the dry ones heal, the wet ones rot in direct proportion as the moisture accumulates. Scabbing typically illustrates what has just been said of drying and healing, as does the influence of poultices in promoting effusion and suppuration, and *pari passu* preventing cicatrisation. It has long been a matter of common knowledge that heat and moisture promote putrefaction; and, since bacteriology has been closely studied, it has been proved that, as a general proposition, moisture is essential to the development of bacteria, thus explaining the antiseptic action of dry and absorbent dressings. While, as a rule, dry wound-dressings are to be preferred, it may sometimes be desirable to moisten them, or to protect the edges with boracic, elemi, zinc, or other ointment, to prevent too great adhesiveness. In the widely varying conditions of wounds, local and constitutional, healthy and diseased, principles must in practice be subordinated to special indications, and therapeutic resources be judiciously combined; but, as a rule, the drier wounds are kept the more quickly do they heal, and proportionately less is the amount of suppuration.

A great variety of materials has been employed in the preparation of absorbent wound-dressings, which may be treated with any antiseptic, but the absorbent gauze and cotton tissue manufactured by Robinson & Son, Chesterfield, is, probably, one of the very best materials for surgical dressings—very cheap, absolutely pure, and powerfully absorbent; it is also very elastic, has a perfectly level surface, is of uniform thickness, and may be folded and cut to any shape. It requires to be used freely to make efficient padding for equable compression. Soaked with collodion, paraffin, or plaster of Paris, the tissue makes an efficient splintage, and by enclosing within a fold or roll of the tissue picked oakum or tenax, pads may be prepared of great use in cases attended with profuse discharge.

The cotton-wool treatment long since advocated by Mayor and Burggraeve, and more recently by Guérin, is carried out with greater facility and thoroughness when absorbent cotton or tissue is employed. The very process by which the cotton is rendered absorbent is one of depuration antagonistic to wound-putrescence, and the deprivation of fatty matter renders cotton more elastic and a better medium for the application of equable pressure. This is specially exemplified in the treatment of

Contused and Lacerated Wounds.—Bruising or contusion may complicate an incised wound, and sometimes, especially over bone, a blow may produce a wound with such well-defined edges that it may be extremely difficult to say whether it have been produced by a cutting instrument or by a blow. In such a case the wound may be treated as an incised wound, special care being taken to provide for the drainage of any existing or succeeding subcutaneous extravasation. There is also greater need for uniform elastic pressure, because the swelling which immediately attends a contused wound is essentially hæmorrhagic, and is best constrained by equable compression with absorbent elastic materials. More commonly contused wounds are also lacerated, and care has to be taken in effecting apposition not to introduce sutures and draw upon soft parts, the vitality of which is so much compromised that very slight violence may suffice to extinguish it. Some parts of a contused wound may well bear sutures; in others the apposition may be well secured by strips of plaster, and, better still, by absorbent gauze or lint, soaked in collodion, styptic colloid, or compound tincture of benzoin. Provision being made for drainage, and a compressing absorbent pad adjusted with accurately applied bandage, attention being paid to physiological position and immobility, the wound may be left with impunity for some days; and it is remarkable to note how extensively torn and bruised wounds so treated often heal by the first intention. Local pain, rise of temperature, and other signs of constitutional disturbance, are obvious indications for inspecting the injured part; but if the first dressing be perfectly accurate, and physiological position and absolute rest enjoined, the healing of contused and lacerated wounds is often rapid and uncomplicated. It may be a question whether much bruised parts should be cut away before apposition is effected. It may be prudent to do so when the crushing has obviously proceeded to the extinction of local life; but if there be any doubt, chance of recovery should be allowed. The styptic applications recommended have a decided antiseptic action, and the absorbent pads take up the products of disintegration. Under the circumstances just referred to, borax, bismuth, or iodoform powders have a

beneficial drying and anti-putrescent action.

In amplification of the preceding general sketch of wound-treatment, reference may be made, in addition to the articles already quoted, to the following : ADHESION ; COLD ; COLLODION ; DRAINAGE ; IMMOBILITY ; IRRIGATION ; POSITION ; PRESSURE ; REST ; SUSPENSION. It now remains to offer some observations on prognosis, constitutional influences, and comparative physiology and therapeutics, in connection with wound-treatment.

Prognosis of Wounds.—A wound being visible presents no diagnostic difficulty so far as the mere question of its existence is concerned; but in determining the parts involved, the presence of foreign bodies, and other complications, ample scope for diagnostic accuracy presents itself as an important preliminary to prognosis and treatment.

In prognosticating the effects of wounds, it is essential to bear in mind that all solutions in the continuity of living tissues are important until completely healed; since some of the most trivial wounds every now and then prove fatal, and complications, such as blood-poisoning and tetanus, sometimes appear when cicatrisation is far advanced. Wounds are not necessarily dangerous in proportion to their extent; thus, a scalp half-torn from the cranium may heal by the first intention after re-adjustment, while a very small wound on the vault may imminently endanger life, in consequence of penetration through the bone, constituting that most formidable lesion, a punctured fracture of the skull. For obvious anatomical reasons, exceptional danger attaches to, and special treatment is required in, wounds into the large visceral cavities, into the joints, and in the course of the great blood-vessels and nerves. Those are matters fully dealt with under separate headings throughout this work.

Constitutional Influences and Treatment.—Irrespective of position and extent, the constitutional state has a direct bearing on the issue of all wounds. Patients suffering from albuminuria and diabetes do badly after comparatively trivial injuries; and it is always prudent to take the constitutional state into careful consideration, in prognosticating the course of wounds after operation or accident. The thermometer, and the pulse and respiration ratio, yield the most reliable diagnostic and prognostic data. So long as those are satisfactory, the constitutional powers unimpaired, and the main sources of blood and nerve supply uninjured, very formidable-looking wounds heal, as a rule, under good management. No precise rules can be laid down for saying what wounds may heal; and the question of amputation is often debated on the assumption that a particular lesion is so extensive as to preclude the possibility of local repair. But experience justifies very great faith in recuperative powers. Conceding that some lives have been lost for want of timely amputation, there is good reason for believing that not a few limbs are sacrificed which might be saved by carefully putting into practice the physiological principles of wound-treatment. A clear perception of correct principles is obviously important; but accurate and painstaking, gentle and thorough manipulation in dressing is not less essential.

The surgeon has to take constitutional influences into consideration in determining the propriety of wound-making in a variety of operations. The well-known disposition to hæmorrhage in some constitutions—bleeders popularly so called—weighs against the performance of all but vitally important operations, and imposes the necessity of extreme care whenever a solution of continuity occurs by accident or design. Phthisis, scrofula, and syphilis powerfully affect the progress of wounds, and demand appropriate treatment in the several conditions. There can be no doubt that temperate persons, other things being equal, exhibit superior powers of healing, to say nothing of the delirium tremens so apt to follow injuries after habitual intemperance. Nervousness is a disturbing cause in wound-convalescence, and renders exceptionally important the precautions which should always be observed to avoid giving pain and alarming patients. The value of anæsthetics in fulfilling those objects is too well known to need more than reference; but what is scarcely sufficiently appreciated is the possibility of avoiding almost all pain in wound-dressing, by extreme lightness and nicety of manipulation.

In watching the constitutional state of a wounded patient much may be learned from the expression, manner, and position. The pulse and respiration ratio is an indicator of first importance; and so is the temperature of the skin to the touch, still more so to the thermometer. A rise of the latter by two or three degrees is always important, but not necessarily alarming. Such rise not infrequently occurs after irregular action of the bowels, a detail apt to be overlooked. A mild aperient or

an enema frequently brings down the temperature to normal in a very few hours. Amongst the agencies powerfully influencing the constitution, diet, tranquility, and ventilation must not be overlooked. As a rule, patients after injuries require liberal diet, but excess may be as great an evil as deficiency. If sufficient food be taken, the need for stimulants is proportionately less; but the symptoms and needs of particular patients must be watched and met, independently of any theoretical preoccupation. Tranquility, mental and bodily rest, cannot be too complete, while ventilation without cold draughts is obviously important. Close, small rooms have caused the death of many persons suffering from wounds, whose local and constitutional condition might speedily have been changed by removal into a larger apartment or to the outer air under the cover of a tent.

In illustration of the science and practice of wound-treatment in the human subject, valuable information may be derived from the

Comparative Physiology of Wound-healing and Therapeutics.—That the process of repair after wounds and injuries generally is only an adaptation and extension of the physiological process of nutrition, is a truth borne out alike by original research and clinical observation in the study of man and animals. The direct bearing of comparative anatomy and physiology on the study of those sciences in immediate relation to man is admitted by common consent; but comparative pathology is less frequently appealed to, though at least as fruitful in lessons bearing directly on the practice of human surgery. That is especially so in the matter of wounds. Suppuration after injuries is comparatively rare in brutes, healing of their wounds usually rapid and uncomplicated. Whereas even small wounds in man are attended with serious and sometimes fatal results, recovery is almost the invariable rule, even after large wounds, in animals. The difference has a great bearing on the etiology of suppuration and on the question of wound-treatment, and is due to a variety of causes, constitutional and physical. Beasts are always temperate, and in comparison with many men virtuous. Their procreation is largely governed by interested intelligence, and they are consequently comparatively free from the blighting and rotting operation of hereditary disease. The horizontal position of animals is favourable to drainage; when at rest they are not smothered under clothing which prevents bodily ventilation and confines heat, which is a potent factor in putrefaction; and the open air which animals usually inhabit is favourable to wound-drying and scabbing. This very exposure to the air is an exceptional cause of one form of traumatic death of animals after injuries—that is, tetanus. It is important to bear in mind the traditional use in veterinary practice of such antiputrescents as preparations of tar and turpentine, sulphate of copper and corrosive sublimate, and the tinctures of aloes, benzoin, and myrrh. But the fact that healing of the wounds of animals can be safely relied upon in the open air is not consistent with the doctrine which, assuming the maleficent potency of ubiquitous atmospheric germs, gives elaborate directions for their destruction.

The treatment of wounds by exposure to the air, which is favourable to drying and scabbing, and the treatment by irrigation, which opposes putrefaction in proportion as it favours drainage and reduces local heat, however different at first sight are alike antiseptic methods, acting on such well-established antiputrescent agencies as drainage and drying. The same remark applies to the combination of rest, position, and pressure, with absorbent and infrequent dressing. In a wounded limb accurately adjusted, compressed, dried, immobilised, and suspended, muscular, nervous, and vascular activity are reduced to the minimum consistent with bare life and physiological repair; while pathological change is prevented by removal of existing and possible causes of irritation, and by interception of putrescible material. Scientific explanation apart, experience proves that the tendency of wounds to heal is naturally very strong; and that great success may be obtained in assisting that natural disposition by a wide variety of plans, provided they be carried out with technical accuracy and thoroughness, conformably to sound physical and physiological principles.

SAMPSON GAMGEE.

WRIST-JOINT, Amputation at the.—This is an operation now seldom performed, having obtained, in the writer's opinion, a somewhat ill-deserved disrepute. It may be done by—(1) the circular, (2) the elliptical, (3) the antero-posterior, (4) the single lateral-flap methods. These are generally known as the operations respectively of Velpeau, Guérin, Lisfranc, and Dubrueil.

The position of the joint can be determined, according to Malgaigne, by either

strongly bending back the hand, when at the summit of the angle formed by it and the forearm the articulation will be found; or again, by drawing a line between the styloid processes, two and half lines above this imaginary line corresponding to the joint. In performing this operation, great care should be taken, during the disarticulation, not to open the radio-ulnar joint, as a wound of it may ultimately lead to impairment in, or loss of, the movements of pronation and supination of the forearm. When the radio-carpal joint is opened, therefore, the point of the instrument should be directed towards the carpus, and not in the direction of the articular surfaces of the radius and ulna. By doing this, the chances of wounding the radio-ulnar joint and triangular fibro-cartilage are minimised.

In performing the *circular operation*, an assistant should retract the skin, and an incision on a level with the bases of the metacarpal bones should then be made. In this incision the skin only should be involved. It should be dissected back as far as the radio-carpal-joint—the position of which has previously been determined with accuracy—the tendons should then be divided, and the joint opened either from before backwards, or from side to side. The radial, ulnar, and occasionally the interosseous arteries are, as a rule, the only vessels requiring ligation. Drainage is in this operation most desirable, as, in the event of suppuration, there is a danger arising from purulent collections forming within the tendinous sheaths. It has been advised to divide these to 'the extent of one or two inches' to prevent these purulent collections. This procedure is, however, in the writer's opinion, quite unnecessary.

Flap amputations at the wrist-joint cannot conveniently be made by transfixion, owing to the convexity of the carpus posteriorly and to the bony prominences and concavity in front. The flaps, therefore, had better be made by division of the parts from without inwards.

The *elliptical method of Guérin* consists in dissecting a full-sized flap from the palmar aspect of the joint. In order to get a more accurate adaptation of the edges of the wound, a dorsal incision, with its convexity looking upwards, should be made; and, on the disarticulation being made, the single palmar flap is then brought over the articular surfaces of the radius and ulna. Care should be taken to commence the incisions well below the styloid processes, as otherwise there is a danger of protrusion of these processes through the wound.

The *antero-posterior flap method of Lisfranc* consists in making an anterior or palmar flap by transfixion, a narrow, double-edged knife being used for the purpose, and a dorsal flap equal in length is then made by dissection. The hand is kept in the position of pronation during the formation of both these flaps. The joint is then opened at the styloid process of the radius, and disarticulation thus effected.

Another method of amputation at the wrist is one of which the writer has had experience, and entertains a favourable opinion. Mention is made of the procedure by Bell, and it is described by M. Dubrueil as follows:—'Commencing just below the level of the articulation, while the hand is pronated, the surgeon makes a convex incision, beginning at the junction of the outer and middle thirds of the arm behind, reaching at its summit the middle of the dorsal surface of the first metacarpal, and terminating in front, just below the palmar surface of the joint, at the junction of the outer and middle thirds of the breadth of the arm. The flap being raised, the wrist is disarticulated, beginning at the radial side. A circular incision finishes the cutting of the skin.'

The cases in which amputation at the wrist is mainly indicated are extensive compound comminuted fractures of the carpus and metacarpus, resulting usually from gunshot injuries, crushing from machine accidents, caries of the carpus and metacarpus too extensive to justify resection, burns, and gangrene. William Stokes.

WRIST-JOINT, Diseases of the.—Acute inflammation of the wrist-joint is usually traumatic, rheumatic, or pyæmic. The intercarpal joints are frequently involved in the same process which attacks the radio-carpal joint; so also are the sheaths of the adjacent tendons.

Chronic disease of these joints is most often of scrofulous origin, but is also not uncommonly the result of the degeneration of inflammatory products in old or ill-nourished persons, after the subsidence of a more acute traumatic inflammation. It is also met with in the form of osteo-arthritis.

Acute inflammation of the wrist and carpal joints gives rise to pain, heat, and swelling. The pain is often severe, and greatly aggravated by the least movement. The swelling is most obvious over the back of the joint.

For *treatment*, rest must be ensured to the joint by applying a splint to the palmar surface of the forearm and hand, which

should reach only to the junction of the palm with the fingers. The most comfortable form of splint is one with a broad surface for the palm and a separate hollow for the thumb. The forearm should then be slung, or placed on a pillow with the hand well raised. Leeches, cold, or soothing lotions can then be applied, and, after the subsidence of the acuter symptoms, blisters, or pressure by strapping or bandaging over a layer of cotton-wool.

If suppuration occurs, the joint must be opened and drained.

Chronic Synovitis usually affects both wrist and carpal joints, and leads to pulpy thickening of the synovial membrane, and often to similar changes in the synovial sheaths of the adjacent tendons. When progressive, much inflammatory thickening of the tissues outside and around the joint occurs; indolent suppuration ensues, and the bone-surfaces become carious, or perhaps some of the carpal bones completely necrosed.

The early stages of the disease should be *treated* by long-continued rest (best ensured by well-moulded leather splints) and careful attention to the general health. The occasional use of the actual cautery, lightly applied, is often most beneficial.

When suppuration has occurred, the abscess must be opened or sinuses slit up, and the diseased tissue scraped away. Sometimes, one or two of the carpal bones may be found necrosed and their removal be followed by repair; but the result of these cases is often unsatisfactory, especially in persons after middle life. At the best, there is generally much stiffness both of the wrist and of the tendons, which a long course of passive movements only partially overcomes. In young persons, especially if scrofulous, long perseverance in treatment, both local and constitutional, is desirable before proceeding to operative interference. When, however, the joint seems hopelessly disorganised, excision may be performed. But, in the elderly, the surgeon will usually be reluctantly driven to amputate.

J. Warrington Haward.

WRIST, Dislocations of the.—Under this heading will be described the dislocations of the wrist-joint proper and those of the lower radio-ulnar joint.

Wrist-joint or Radio-carpal Dislocations are very rare, and must not be confounded with fractures of the lower end of the radius, which somewhat resemble them. There are three forms—viz. *backwards*, *forwards*, and by *rotation backwards*, given in the order of their relative frequency.

Dislocation backwards of the carpus was believed to be a common accident until Colles and Dupuytren, at the beginning of this century, pointed out that the injury which usually gave rise to the deformity attributed to dislocation was a fracture of the lower end of the radius, now known as Colles's fracture. The signs of dislocation backwards are a projection on the back of the wrist, stretching from side to side, convex superiorly, and about eight lines in height. Anteriorly, there is a projection ending abruptly below, on the margins of which may be felt the styloid processes of the radius and ulna. The first row of phalanges is semiflexed on the metacarpus, and the terminal nearly straight. The forearm, measured from the tip of the olecranon to the head of the middle metacarpal bone, will be found shortened.

Dislocation forwards of the carpus gives rise to a sharp prominence behind (caused by the radius and ulna), which ends abruptly below, and is there concave. In front, the carpus forms a rounded projection. The posterior aspect of the hand appears shortened, and measurement from the olecranon to the head of the third metacarpal bone is abnormally short.

Dislocation by rotation backwards resembles what the writer has termed dislocation by rotation backwards at the metacarpo-phalangeal joint of the thumb, and he believes it has never yet been described. The case on which he founds his description was that of a plumber, aged thirty-one, who came into Guy's Hospital one evening in May, 1884, without hat or coat. He stated he had been fighting with another man, and, being surprised by the police, had run away to escape being taken into custody. In running, he slipped and fell on his left hand, which remained immovably fixed in a state of over-extension. The hand was found forced back, so that the metacarpus formed as nearly as possible a right angle with the dorsal surface of the forearm. The first phalanges were flexed at a right angle with the metacarpus, and the middle and terminal phalanges slightly flexed. The carpus pressed forward the tendons in front of the wrist, but beyond this there was no deformity. The carpus had become over-extended on the radius and ulna without rupture of the lateral ligaments, and the dorsal surfaces of the first row lay in contact with the articular surface of the radius and the inter-articular cartilage. The man was semi-intoxicated, and absolutely refused to take an anæsthetic or morphia. Extension by the aid of assistants,

over-extension and then flexion, flexion by the aid of assistants and by bending across the knee, were all tried without success. The joint was absolutely locked. He was left for the night, in the hope that when his head was clearer in the morning he would submit to an anæsthetic, but on this being again pressed upon him, he left the hospital unrelieved.

The *treatment* of dislocation forwards or backwards is to extend the hand by grasping the palm, and, as the lateral ligaments have been ruptured, little difficulty has been found in reducing the bones. An anterior splint, reaching from the bend of the elbow to the middle of the palm, should afterwards be worn for three weeks.

Radio-ulnar Dislocations at the Wrist are those in which the hand, together with the radius and triangular fibro-cartilage, become displaced from the ulna. They are described by some authors as luxations of the lower extremity of the ulna, owing to the prominence assumed by this bone when the hand is displaced from it.

As a complication of fracture of the radius, displacement at the lower radio-ulnar joint, either partial or complete, is frequent. In the majority of Colles's fractures, the lower end of the ulna is unduly movable and prominent, owing to partial dislocation of this joint, and the cases in which the ulna protrudes through the skin are almost invariably associated with fracture of the radius. There are, however, some uncomplicated cases on record. The hand and radius may be displaced either *forwards* or *backwards* from the ulna, without fracture, but when displaced *outwards* it appears always to have been associated with fracture of the radius.

Dislocation forwards is usually caused by forced pronation. It has been produced in children by lifting them by the hands when pronated. The hand is found in a state of semi-pronation and adduction, whilst the lower end of the ulna makes a very distinct prominence on the back of the wrist, escaping externally to the extensor carpi ulnaris, and riding on the back of the radius, so that the wrist is narrowed. In front there is a depression, which the flexor carpi ulnaris is seen to cross.

To reduce the dislocation, pressure should be made on the projecting ulna at the same time that the hand is supinated. Should there be a tendency to reluxation, an anterior splint should be applied, and a pad to keep down the ulna.

Dislocation backwards is rather less frequent than dislocation forwards. It has been caused by forcing the hand strongly into a state of supination. The hand and radius are thrown backwards, and the lower end of the ulna forms a projection in front near the middle of the wrist. On the back of the wrist the deformity is characteristic, for in the position of the lower end of the ulna there exists a well-marked depression. The hand is supinated, and the patient lacks the power of pronating it.

To reduce it, the hand should be abducted and pronated, at the same time that pressure is made on the lower end of the ulna.

Complicated Radio-ulnar Dislocations.—It has been before remarked that, with a fracture of the radius, there may be a great displacement at the radio-ulnar joint, the lower end of the ulna sometimes passing through the skin. In 1882, a dissipated old woman, running to escape from a vehicle, fell on both palms, and was brought to Guy's Hospital with a simple Colles's fracture of one wrist and a compound fracture of the other radius, complicated with protrusion of the lower end of the ulna through the skin, just externally to the flexor carpi ulnaris. There was no difficulty in reduction, and she was at first treated as an out-patient, but phlegmonous erysipelas followed, and she was admitted under the writer's care. Much sloughing took place, necessitating amputation, and she died from exhaustion and degenerate organs. Somewhat similar cases in which the ulna projected through the skin, in one case at the back of the carpus, and in another on the inner side, are described by Cooper. Godlee brought before the Clinical Society, in 1883, a case of compound fracture of the radius, complicated with projection of the lower end of the ulna in front of the flexor carpi ulnaris tendon, which he found impossible to reduce until he had cut down upon, and had sawn off, the articulating surface of the bone. Commenting on his case, he remarked that little deformity or impairment in usefulness resulted from excision of the lower end of the ulna—an observation previously made by the writer of this article before the same society in 1877, when exhibiting a case in which the bone had been excised for tumour.

R. Clement Lucas.

WRIST-JOINT, Excision of the. *See* Joints, Excision of.

WRYNECK. *See* Torticollis.

X

XANTHOMA (*Synon.* Xanthelasma). *Definition.*—A rare affection involving the integument, and subsequently the areolo-fibrous structure, due to the presence of a peculiar yellow-coloured growth, or deposit composed of cells and connective tissue.

Etiology.— Additional information is much needed concerning the conditions of the body which predispose to and determine this rare affection. They are, however, to be associated with defective vital power involving the nutrition and growth of certain tissues. It has been considered probable that some functional disorders of the liver, if not actual structural disease, may stand in causal relationship to xanthoma, not only because jaundice has frequently been associated with it, but also for the reason that organic disease of the liver has frequently been demonstrated *post mortem* to have co-existed with it.

In a report upon twenty-eight cases of xanthoma multiplex in adults, published in 1882, jaundice was present in twenty-three instances, while diabetes mellitus existed in one only of the remaining five. In eight cases of the same disease occurring congenitally, or commencing under puberty, jaundice was reported to be entirely absent. One case is on record in which many organs of the body were simultaneously diseased.

It is obvious, therefore, that as yet no one morbid condition has been found the constant accompaniment of the malady—indeed, in some persons no disorder of the general health has been noticed. Instances have been recorded of xanthoma present at birth or developing in early infancy. Heredity has been proved to be an occasional factor in the disease.

Among the conclusions derivable from the study of the above-mentioned cases of xanthoma multiplex, it may be noted that, etiologically, the cases occurring before puberty differ from those in adult life in having no traceable connection with jaundice or hepatic disease, they are probably to an extent hereditary and may be congenital, moreover they do not affect the eyelids, but involve other regions of the trunk and extremities. It may also be observed that, in four-fifths of the cases of xanthoma multiplex commencing after puberty, chronic jaundice from obstruction of bile-ducts existed, while in several of the remainder there had been no disorder of health. Lastly, in these the eyelids were almost constantly involved, and were generally the starting-point of the disease.

Spontaneous disappearance has been noted. The sexes would seem to be about equally affected. A case has recently been reported exhibiting the plane, tubercular, and tuberose varieties of the disease with perfect symmetry, except for a corymbose band on the right side of the trunk in the trajectory of some cutaneous nerves, and possibly determined by a zona. The patient was a man forty-four years of age, and had an enlarged liver with jaundice of twelve years' standing, which had greatly darkened the skin and was attended with pruritus. The xanthoma had developed in four years, and commenced in the gluteal region. A trace of sugar, but no albumen, was found in the urine.

Anatomical Characters.—Xanthoma is a benign growth or deposit in the cutaneous, mucous, and serous structures, and occasionally, as aforesaid, in the subjacent areolo-fibrous tissue. On microscopical examination, it is evident that the opaque yellow colour is produced by masses of a substance composed of cells of irregular form and size, round, oval, triangular, or rod-shaped, which later may undergo degeneration, and give rise to a crystalline appearance in their midst, or to a fatty metamorphosis with cholesterine plates. These cells are contained in an areolar network of connective tissue.

Description.—Xanthoma presents itself: (1) as isolated tubercles or nodules—X. tuberosum; (2) as smooth laminæ or plates—X. planum.

In the tuberous variety the tubercles are of a yellow colour, isolated or grouped, smooth, and conveying a soft or somewhat elastic sensation to the touch. The planar variety occurs in the form of defined yellow patches or plâques. Upon the palm, a linear arrangement may be present, corresponding to the natural markings or creases.

When it occurs in both its forms, the term X. multiplex is applied. Xanthoma upon the eyelids (X. palpebrarum) is known

by the presence of more or less elevated, rounded, or oblong spots of yellow colour, solitary or multiple. It has a remarkable predilection for the inner angle of the upper eyelid, where it generally commences, is often symmetrical, and later attacks the inner angle of the lower lid.

Occasionally, in severe cases, the whole palpebral aperture may be surrounded by a series of these patches more or less closely arranged. The presence of granules occasionally upon the surface with punctated apertures, corresponding to enclosed follicles, has given rise to the term X. granulosum as descriptive of this variety. Unirritated, they are painless.

Inflammatory symptoms are absent, and the surrounding skin has a brownish or pigmented appearance. While the disease was originally observed upon the eyelids, recorded instances have proved its existence on the palms, soles, knuckles, ears, elbows, face, back, abdomen and penis, &c. The mucous membrane of the lips, palate, tongue, also the trachea, bile-ducts, sub-peritoneal tissue of abdomen, and some abdominal organs, have been implicated.

Diagnosis.—The position and arrangement, colour, structure and general characters as described will suffice to determine the affection, no other cutaneous disease having any approximate resemblance to it. The course it pursues is essentially chronic.

Prognosis.—The growth is comparatively unimportant except for its appearance. Internal remedies have no effect upon it. Spontaneous disappearance has occurred.

Treatment.—The general health and requirements of the patient should be attended to, and disordered functions regulated, &c. However, local measures, and of these the use of caustics and removal with the knife, alone can effectually dispose of the disease, should it be deemed expedient to interfere. Much caution should be exercised about the eyelids if surgical means be adopted, on account of possible after-contraction.

J. Herbert Stowers.

XERODERMA, or ATROPHODERMA PIGMENTOSUM.—*Definition.* A disease of congenital origin characterised by a pigmented atrophy of the skin, and the development of papillomatous tumours which may become cancerous.

Etiology.—Nearly all the cases recorded, less than forty in number, have commenced in the second year of life; both sexes are equally liable, but generally when several members of the same family are attacked, as often happens, it selects either the girls or the boys, but not both. Although there is evidently some congenital predisposition, the disease does not develop for some time after birth. It cannot be ascribed to heredity or defects in hygiene, but exposure to the sun has been thought to be an exciting influence. Its real cause, however, is unknown.

Symptoms. — The children are born healthy, and no defect is noticed until the second year, when freckle-like pigmentation of all shades of light and dark brown occurs, sometimes preceded by erythematous papules, and limited to the exposed parts of the body.

Telangiectases develop between the freckles, and subsequently undergo obliteration and leave the skin white and atrophic, like a thin scar. The pigment-spots enlarge and get a deeper tint, and warts develop on them like those of the aged, and from these papillomatous tumours arise, which fungate, and may form masses as large as an orange ; or less raised ulcerated patches occur, covered with blood-crusts. These tumours and ulcers may become epitheliomatous, and lead to the death of the patient. The eyes are often affected with conjunctivitis and pannus, and the constant discharge causes some of the ulcers, owing to the pus becoming inoculable. The general health is quite good unless the discharge becomes profuse or cancer develops. Death has occurred about puberty in many instances, but others have reached adult life.

Diagnosis. — If all the symptoms be taken into account, and the history of their development is known, no difficulty can occur, as it is only in some features that it can resemble lupus or atrophic scleroderma, while the rest are very different.

Treatment.—Nothing can be done in the way of cure, but the progress can be delayed by careful attention to the eyes, protecting them and bathing them frequently with boracic acid lotion. The ulcers should be scraped with a sharp spoon if fungating, and healed by the usual means for ulcers, and the tumours removed; fresh ulcers can usually be healed by removing the crust, and dressing them with an ointment of ammoniated mercury, gr. x. to the ounce of lard, or sometimes boracic acid ointment, gr. x. to the ounce, is preferable. No internal medication has any direct effect, but tonics and cod-liver oil may be required.

H. Radcliffe Crocker.

XEROSIS or XEROPHTHALMOS. *Causes and Pathology.*—Granular ophthalmia; diphtheritic ophthalmia; improper use of caustic applications. Conjunctival xerosis may also occur as a primary disease, especially in young children, and then leads to total destruction of the eye by ulceration of the cornea, &c., while the patients die of general malnutrition. In a case of this kind the presence of micro-organisms has been demonstrated in the conjunctiva, and similar bodies were found in the pelves of the kidneys. A remarkable, and as yet unexplained, association of night-blindness with conjunctival xerosis is sometimes seen sporadically or epidemically, the latter chiefly in foreign barracks and prisons. In this form of the affection, similar bacilli have been found in the conjunctiva.

Symptoms and Diagnosis.—This is a dry, lustreless condition of the conjunctiva. Whitish-grey epithelial scales come away from the mucous membrane, which is contracted in extent. This contraction may be ascertained by drawing down the lower lid, when the inferior fornix will be found to have almost disappeared, and the degenerated conjunctiva to stretch across from the margin of the lower lid to the margin of the cornea. The cornea takes part in the process, its epithelium losing its lustre, with consequent defect of vision.

Treatment.—There is no cure for this condition. Palliation of the distressing symptoms alone can be attempted. Collyria of milk and glycerine, to which may be added some bicarbonate of soda, are the most useful applications, and the eyes should be carefully protected from all irritating influences. H. R. Swanzy.

Z

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Chloasma; Lentigo; Leucoderma; Pemphigus; Urticaria.

CHARNLEY, WILLIAM, M.A., M.D., M.C., *Surgeon to the Central London Ophthalmic Hospital.*

Errors of Refraction; Retinoscopy.

CHAVASSE, THOMAS FREDERICK, M.D., C.M., *Surgeon to the Birmingham General Hospital.*

Injuries of the Abdomen; Rupture of the Liver and Spleen.

CHEYNE, WILLIAM WATSON, M.B., C.M., *Assistant Surgeon to, and Demonstrator of Surgery at, King's College Hospital.*

Inflammation; Antiseptic Surgery; Antiseptics.

CLARKE, W. BRUCE, M.A., M.B., *Assistant Surgeon to, and Demonstrator of Operative Surgery at, St. Bartholomew's Hospital; Surgeon to the West London Hospital.*

Cysticercus Cellulosæ; Pediculi.

CLUTTON, HENRY HUGH, M.A., M.B., *Assistant Surgeon to, and Lecturer on Forensic Medicine at, St. Thomas's Hospital.*

Diagnosis of Diseases of Bones; Caries; Necrosis; Ostitis; Osteomyelitis, and other Special Articles on Diseases of the Osseous System; Subperiosteal Resection; Tumours of Bone.

COLES, OAKLEY, *Dental Surgeon to the Hospital for Diseases of the Throat.*

Mechanical Treatment of Cleft Palate.

COWELL, GEORGE, *Surgeon to, and Lecturer on Surgery at, the Westminster Hospital; Surgeon to the Royal Westminster Ophthalmic Hospital, and to the Victoria Hospital for Children.*

Congenital Dislocations; Intra-uterine Fractures.

CRIPPS, WILLIAM HARRISON, *Assistant Surgeon to St. Bartholomew's Hospital.*

Bruises; Wounds of Arteries; Hæmorrhage; Transfusion.

CROCKER, HENRY RADCLIFFE, M.D., B.S., *Physician to the Skin Department, University College Hospital; Physician to the East London Hospital for Children.*

Elephantiasis Græcorum; Fungous Disease of India; Erythema; Filaria Medinensis; Ichthyosis; Molluscum Fibrosum; Purpura; Sclerema Neonatorum; Scleroderma; Striæ et Maculæ Atrophicæ; Xeroderma.

CROSSE, THOMAS WILLIAM, *Surgeon to the Norfolk and Norwich Hospital.*

Urinary Calculi; Stone in the Female Bladder; Stone in the Urethra.

CRUISE, FRANCIS R., M.D., *Consulting Physician to the Mater Misericordiæ Hospital, Dublin.*

Endoscope.

CUMBERBATCH, A. ELKIN, M.B., *Aural Surgeon to St. Bartholomew's Hospital, and to the Great Northern Hospital.*

Diseases of the External and Middle Ear.

DAVIES-COLLEY, J. NEVILLE C., M.A., M.C., *Surgeon to, and Lecturer on Anatomy at, Guy's Hospital.*

Boils; Cadaveric Warts; Carbuncle; Malignant Pustule; Glanders; Gonorrhœal Rheumatism; Diagnosis of Swellings and

Tumours of the Neck; Wounds of Jugular Vein and other Special Articles on Injuries of the Neck and Throat; Injuries and Diseases of the Œsophagus; Œsophagotomy; Scalds of the Larynx; Sinus.

DENT, CLINTON THOMAS, *Assistant Surgeon to, and Lecturer on Practical Surgery at, St. George's Hospital; Surgeon to the Belgrave Hospital for Children.*

Ankylosis; Ligatures; Junks; Diphtheria of Wounds; Vomiting.

DORAN, ALBAN HENRY GRIFFITHS, *Assistant Surgeon to the Samaritan Free Hospital.*

Amputation of the Cervix Uteri; Stenosis of the Cervix Uteri; Emmet's Operation; Extra-uterine Fœtation; Pelvic Abscess in the Female; Pelvic Cellulitis; Pelvic Hæmatocele.

DUCKWORTH, DYCE, M.D., *Physician to, and Lecturer on Clinical Medicine at, St. Bartholomew's Hospital.*

Charcot's Disease; Chronic Rheumatic Arthritis.

DUNCAN, JOHN, LL.D., M.A., M.D., *Surgeon to the Edinburgh Royal Infirmary.*

Electrolysis.

EVE, FREDERICK S., *Pathological Curator of the Museum, Royal College of Surgeons; Assistant Surgeon to the London Hospital.*

Polypi.

FENWICK, E. HURRY, *Assistant Surgeon to the London Hospital.*

Hæmaturia.

FIELD, GEORGE P., *Aural Surgeon to, and Lecturer on Aural Surgery at, St. Mary's Hospital.*

Aural Exostosis.

FITZ-GERALD, THOMAS NAGHTEN, *Surgeon to the Melbourne Hospital, Victoria.*

Hydatids.

GAMGEE, JOSEPH SAMPSON, *Consulting Surgeon to the Queen's Hospital, Birmingham.*

Wounds; Adhesion; Cold; Drainage; Immobility; Rest; Irrigation, and other Special Articles on the Treatment of Wounds.

GODLEE, RICKMAN JOHN, B.A., M.S., *Surgeon to University College Hospital; Teacher of Operative Surgery and Assistant Professor of Clinical Surgery in University College, London; Surgeon to the Hospital for Consumption, Brompton.*

Abscess; Empyema; Facial Palsy; Facial Spasm; Paracentesis.

GOLDING-BIRD, CUTHBERT H., B.A., M.B., *Assistant Surgeon to, and Lecturer on Physiology at, Guy's Hospital.*

Caries of the Spine; Lumbar Abscess; Psoas Abscess; Retro-pharyngeal Abscess.

GOULD, ALFRED PEARCE, M.S., *Assistant Surgeon to the Middlesex Hospital; Surgeon to the Royal Hospital for Diseases of the Chest.*

Diseases of the Testis; Hæmatocele; Hydrocele; Hernia Testis; Castration; Diseases of the Spermatic Cord; Diagnosis of Affections of the Popliteal Space; Wounds of the Popliteal Artery; Popliteal Aneurism; Arterio-venous Aneurism; Contraction of Hamstring Tendons; Varicocele; Varicose Veins; Diseases of the Vesiculæ Seminales.

GOWERS, WILLIAM RICHARD, M.D., *Assistant Professor of Clinical Medicine in University College, and Physician to University College Hospital; Physician for Out-patients to the National Hospital for the Paralysed and Epileptic.*

Pseudo-Hypertrophic Muscular Paralysis.

GUNN, ROBERT MARCUS, M.A., M.B., C.M., *Assistant Surgeon to the Royal London Ophthalmic Hospital, Moorfields; Ophthalmic Surgeon to the Hospital for Sick Children, Great Ormond Street.*

Affections and Injuries of the Optic Nerve; Affections of the Retina.

HAWARD, J. WARRINGTON, *Surgeon to, and Lecturer on Clinical Surgery at, St. George's Hospital.*

Anæsthetics; Diseases of Joints; Excision of Joints; Excision of Os Calcis; Parotid Tumour; Salivary Fistula; Osteo-Arthritis; Synovitis.

HEATH, CHRISTOPHER, *Holme Professor of Clinical Surgery in University College, London, and Surgeon to University College Hospital.*

Abdominal Surgery; Aneurism; Aortic Aneurism; Innominate Aneurism; Diseases of the Jaws; Operations on the Jaws; Affections of the Gums; Dentigerous Cysts, and other Special Articles on Diseases of the Jaws; Fracture of the Alveolus.

HILL, M. BERKELEY, M.B., *Professor of Clinical Surgery in University College, London, and Surgeon to University College Hospital; Surgeon to the Lock Hospital.*

Diseases of the Bladder; Stricture of the Urethra; Extravasation of Urine; Strangury; Perineal Abscess; Bougies; Catheters; La Boutonnière Operation; Diseases and Injuries of the Urethra; Urethrotomy; Urethroplasty; Urinary Fistula.

HOOD, WHARTON P., M.D.
Bone-setting.

HORSLEY, VICTOR ALEXANDER H., M.B., B.S., *Assistant Surgeon to University College Hospital, and Assistant Professor of Pathological Anatomy, University College, London; Superintendent of the Brown Institution.*

Albuminoid Degeneration; Bacillus; Bacterium; Fatty Degeneration; Hypodermic Injection; Micrococcus; Nerve-Avulsion; Nerve-Stretching; Neurotic Fever; Poisoned Wounds; Rigor; Sapræmia; Schizomycetes; Sepsin; Septicæmia; Septic Diseases; Shock; Surgical Fever; Traumatic Fever; Urea; Urethral Fever; Urinary Deposits; Urine; Vibrio.

HOWSE, HENRY GREENWAY, M.S., *Surgeon to, and Lecturer on Anatomy at, Guy's Hospital; Surgeon to the Evelina Hospital for Sick Children, and to the National Truss Society.*

Injuries of the Chest; Rupture and Wound of Heart; Wounds of Lung; Hæmoptysis from Injury; Hæmothorax; Pneumothorax, and other Special Articles on Injuries to the Chest; Femoral Aneurism; Gastrostomy; Gastric Fistula.

HUTCHINSON, JONATHAN, F.R.S., *Consulting Surgeon to the London Hospital; Consulting Surgeon to the Royal London Ophthalmic Hospital; and Surgeon to the Hospital for Diseases of the Skin.*

Syphilis; Congenital Syphilis; Chancre; Finger-chancre; Bubo; Gumma; Vaccination-Syphilis.

JACOBSON, WALTER HAMILTON ACLAND, B.A., M.B., *Assistant Surgeon to Guy's Hospital; Surgeon to the Royal Hospital for Women and Children.*

Diagnosis of Injuries and Diseases of the Foot and Ankle; Bunion; Chilblains, and other Special Articles on Wounds and Affections of the Foot; Perforating Ulcer; Diagnosis of Scrotal Swellings; Injuries and Diseases of the Scrotum; Caries of the Tarsal Bones.

KEETLEY, CHARLES R. B., *Surgeon to the West London Hospital; Surgeon to the Surgical Aid Society.*

Artificial Limbs.

KIDD, PERCY, M.A., M.D., *Assistant Physician to the Hospital for Consumption, Brompton.*

Hæmophilia.

LANGTON, JOHN, *Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; Surgeon to the City of London Truss Society.*

Reducible Hernia; Irreducible Hernia; Taxis; Trusses.

LAWSON, GEORGE, *Surgeon to the Royal London Ophthalmic Hospital and to the Middlesex Hospital.*

Diseases of the Orbit; Injuries of the Orbit; Tumours of the Orbit; Diseases of the Frontal Sinuses; Sympathetic Ophthalmitis.

LIVEING, ROBERT, M.A., M.D., *Physician to the Skin Department and Lecturer on Dermatology at the Middlesex Hospital.*

Skin Diseases; Diseases of the Hair; Achorion Schönleinii; Acne; Acne Rosacea; Acrochordon; Alopecia Areata; Bullæ; Ecthyma; Eczema; Horns; Impetigo; Lichen; Pityriasis; Psoriasis; Tinea Tonsurans; Warts.

LUCAS, R. CLEMENT, M.B., B.S., *Assistant Surgeon to, and Demonstrator of Operative and Practical Surgery at, Guy's Hospital; Surgeon to the Evelina Hospital for Siek Children.*

Dislocations; Special Articles on Dislocations of the Hip, of the Shoulder, and other Joints; Diagnosis of Injuries and Diseases about the Hip, and of Injuries and Diseases about the Shoulder; Wounds of Joints.

McCARTHY, JEREMIAH, M.A., M.B., *Surgeon to, and Lecturer on Physiology at, the London Hospital.*

Injuries and Diseases of the Rectum; Hæmorrhoids; Fistula in Ano; Fissure of the Anus; Prolapsus Ani; Atresia Ani; Recto-vesical Fistula, and other Articles on Diseases of the Anus and Rectum; Injuries of the Pelvis; Hydrophobia; Hypochondriasis; Impotence; Sterility in the Male; Tetanus; Vesico-intestinal Fistula.

MACCORMAC, SIR WILLIAM, M.A., *Surgeon to, and Lecturer on Surgery at, St. Thomas's Hospital.*

Gun-shot Wounds; Sabre and Bayonet Wounds.

MACEWEN, WILLIAM, M.D., C.M., *Surgeon to, and Lecturer on Surgery at, the Royal Infirmary, Glasgow.*

Diagnosis of Head Injuries; Fracture of the Skull; Encephalitis, Meningitis, and Abscess of the Brain; Compression of the Brain; Concussion of the Brain; Hernia of the Brain; Osteotomy; Grafting; Tracheal Catheterism.

MACKENZIE, STEPHEN, M.D., *Physician to, and Lecturer on Medicine at, the London Hospital; Physician to the Royal London Ophthalmic Hospital.*

Chyluria; Filaria Sanguinis Hominis.

McLÉOD, KENNETH, A.M., M.D., *Fellow of the University of Calcutta; Professor of*

Surgery, Calcutta Medical College; First Surgeon, College Hospital.

Delhi Boil; Scrotal Elephantiasis.

MAKINS, GEORGE HENRY, *Surgical Registrar to St. Thomas's Hospital; Surgeon to Outpatients at the Great Northern Hospital, and the Evelina Hospital for Sick Children.*

Surgical Tuberculosis; Phlebitis; Embolism; Fat-Embolism; Thrombosis.

MARSH, F. HOWARD, *Assistant Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; Surgeon to the Hospital for Sick Children, Great Ormond Street.*

Fractures; Articles on Fractures of the Femur, of the Humerus, of the Patella, and other Special Fractures; Hip-Disease.

MASON, FRANCIS, *Surgeon to, and Lecturer on Practical Surgery at, St. Thomas's Hospital.*

Nævus.

MEREDITH, WILLIAM APPLETON, M.B., C.M., *Surgeon to the Samaritan Free Hospital for Women and Children.*

Cholecystotomy; Rupture of Perineum; Female Catheter; Affections of the Female Urethra; Vaginal Fistulæ; Affections of the Vagina and Vulva.

MILLER, A. G., M.D., *Surgeon to, and Lecturer on Surgery at, the Edinburgh Royal Infirmary.*

Injuries and Diseases of Muscles; Rider's Bone; Sprain; Affections of Tendons.

MILLES, W. J.

Diseases of the Ciliary Body.

MORGAN, JOHN HAMMOND, M.A., *Assistant Surgeon to Charing Cross Hospital, and to the Hospital for Sick Children, Great Ormond Street.*

Hydrocele of the Neck; Fissure of the Cheek; Macroglossia; Surgery of the Hand; Ganglion; Dupuytren's Contraction; Congenital Deformities of Fingers; Wound of Palmar Arch; Contraction of Plantar Fascia; Umbilicus and Umbilical Fistula; Webbed Fingers; Whitlow.

MORRIS, MALCOLM ALEXANDER, *Surgeon to the Skin Department of, and Lecturer on Dermatology at, St. Mary's Hospital.*

Acarus; Comedo; Elephantiasis Arabum; Favus; Lupus Erythematosus; Lupus Vulgaris; Milium; Pityriasis Versicolor; Scabies; Tylosis.

MOULLIN, C. W. MANSELL, M.D., M.A., *Assistant Surgeon to the London Hospital.*

Albuminuria; Diabetes; Pyæmia; Foreign Bodies in the Air-passages; Scalds of the Glottis.

MURPHY, SHIRLEY, F., *Assistant Director, Animal Vaccination Establishment of Local Government Board.*

Vaccination.

MURRAY, WILLIAM, M.D., *Consulting Physician to the Newcastle-on-Tyne Hospital for Sick Children.*

Aneurism of the Abdominal Aorta.

OWEN, EDMUND, M.B., *Surgeon to, and Lecturer on Anatomy at, St. Mary's Hospital; Surgeon to the Hospital for Sick Children, Great Ormond Street.*

Bow-leg; Genu Extrorsum; Genu Valgum; Hare-lip; Torticollis.

PAGE, HERBERT WILLIAM, M.A., M.C., *Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital.*

Injuries of the Back and Spine; Disorders of Vision from Injuries of Head and Spine.

PAGET, SIR JAMES, Bart., D.C.L., LL.D., F.R.S., *Sergeant Surgeon to H.M. the Queen; Surgeon-in-Ordinary* to *H.R.H. the Prince of Wales; Consulting Surgeon to St. Bartholomew's Hospital.*

Old Age.

PAGET, STEPHEN, B.A., *Honorary Surgeon to the Western General Dispensary.*

Cancrum Oris; Dysphagia; Sex.

PARKER, ROBERT WILLIAM, *Surgeon to the East London Hospital for Children.*

Surgical Affections of Childhood; Rickets; Affections of the Epiphyses; Separation of the Epiphyses; Laryngotomy; Laryngectomy Spina Bifida; Thyrotomy; Tracheotomy.

PARKER, RUSHTON, M.B., B.S., *Assistant Surgeon to the Liverpool Royal Infirmary; Professor of Surgery in University College, Liverpool.*

Diseases of the Nose; Epistaxis; Nasal Polypus; Nasal Douche; Peritonitis.

PEPPER, AUGUSTUS J., M.S., *Surgeon to, and Teacher of Practical and Operative Surgery at, St. Mary's Hospital; Surgeon to the London Fever Hospital.*

Diseases of Arteries; Diseases of the Lips; Plastic Surgery; Diagnosis of Affections of the Groin; Hypertrophy; Atrophy; Induration; Œdema; Metastasis; Calcification; Suppuration; Suppurative Fever.

PHILLIPS, CHARLES DOUGLAS F., M.D.

Caustics.

PICK, THOMAS PICKERING, *Surgeon to, and Lecturer on Surgery at, St. George's Hospital.*

Erysipelas; Cellulitis; Gangrene; Hospital Gangrene; Phagedæna; Spermatorrhœa; Subclavian Aneurism.

PITTS, BERNARD, M.A., M.C., *Assistant Surgeon to St. Thomas's Hospital; Assistant Surgeon to the Children's Hospital, Great Ormond Street.*

Aspiration; Aspirator; Affections of Stumps; Diagnosis of Affections of Thigh and Leg.

POLLARD, BILTON, M.D., B.S., *Surgical Registrar, University College Hospital.*

Bandages; Immovable Bandages; Bedsores; Esmarch's Bloodless Method; Needles; Specula; Articles on Splints and Surgical Appliances; Styptics; Sutures.

POORE, GEORGE VIVIAN, M.D., *Professor of Medical Jurisprudence in University College, London; Physician to University College Hospital.*

Swallowing of Acids; Swallowing of Alkalies; Pulse; Suspended Animation.

POWER, D'ARCY, M.A., M.B., *Curator of the Museum of St. Bartholomew's Hospital.*

Villous Tumours.

POWER, HENRY, M.B., *Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, St. Bartholomew's Hospital; Surgeon to the Royal Westminster Ophthalmic Hospital.*

Amaurosis; Amblyopia; Asthenopia; Blindness; Diseases of the Lacrymal Apparatus; Feigned Disorders of Vision.

PURVES, WILLIAM LAIDLAW, M.D., *Aural Surgeon to Guy's Hospital.*

Diagnosis of Deafness; Diseases of the Internal Ear.

PUZEY, CHAUNCEY, *Surgeon to the Liverpool Northern Hospital.*

Acupuncture; Surgical Uses of Ergotin; Surgical Uses of Iodoform.

RIVINGTON, WALTER, B.A., M.S., *Surgeon to, and Lecturer on Surgery at, the London Hospital.*

Rupture of the Bladder; Orbital Aneurism.

ROBERTS, FREDERICK THOMAS, M.D., *Professor of Materia Medica and Therapeutics in University College, London, and Physician to University College Hospital; Physician to the Hospital for Consumption, Brompton.*

Delirium Tremens.

ROTH, BERNARD.

Antero-posterior Spinal Curvature; Lateral Spinal Curvature; Flat-foot; Pigeon-breast; Massage; Medical Gymnastics.

SANGSTER, ALFRED, B.A., M.B., *Physician to the Skin Department, and Lecturer on Skin Diseases at, Charing Cross Hospital.*

Bromidrosis; Herpes; Hyperidrosis; Molluscum Contagiosum; Prurigo; Seborrhœa; Medicinal Eruptions; Sycosis.

SEMON, FELIX, M.D., *Assistant Physician for Diseases of the Throat to St. Thomas's Hospital.*

Laryngitis; Neuroses of the Larynx; Syphilis of the Larynx; Tuberculosis of the Larynx; Growths in the Larynx; Laryngoscopy; Aphonia; Dyspnœa; Rhinoscopy; Injuries and Diseases of the Thyroid Gland.

SMITH, PRIESTLEY, *Ophthalmic Surgeon to the Queen's Hospital, Birmingham; Consulting Ophthalmic Surgeon to the Birmingham Skin and Lock Hospital.*

Cataract; Cataract Glasses; Crystalline Lens; Nystagmus; Affections of the Ocular Muscles; Strabismus.

SMITH, THOMAS, *Surgeon to, and Lecturer on Clinical Surgery at, St. Bartholomew's Hospital; Consulting Surgeon to the Children's Hospital, Great Ormond Street.*

Surgical Treatment of Cleft Palate.

SMITH, W. JOHNSON, *Surgeon to the Seamen's Hospital, Greenwich.*

Burns; Accidents from Lightning; Frost-bite; Pathological Conditions of Cicatrices; Aneurism of the Carotid Arteries; Gonorrhœa; Gleet; Mucous Patches; Cheiloplasty; Rhinoplasty; Scurvy.

STOKES, WILLIAM, M.D., M.Ch., *Professor of Surgery at the Royal College of Surgeons of Ireland; Surgeon to the Richmond Surgical Hospital, Dublin.*

Amputations; Amputation at the Ankle; Amputation of the Arm, and other Articles on the Special Amputations through Limbs and at Joints.

STOWERS, HERBERT, M.D., *Physician to the Department for Skin Diseases, North-West London Hospital.*

Xanthoma.

SWAIN, PAUL, *Surgeon to the South Devon and East Cornwall Hospital.*

Diseases of the Penis; Phimosis; Paraphimosis, and other Articles on Affections of the Male Genital Organs; Circumcision.

SWANZY, HENRY R., M.A., M.B., *Surgeon to the National Eye and Ear Infirmary, Dublin; Ophthalmic Surgeon to the Adelaide Hospital, Dublin.*

Diseases of the Conjunctiva; Injuries of the Conjunctiva; Pterygium; Pinguecula.

SYMONDS, CHARTERS JAMES, M.D., M.S., *Assistant Surgeon to Guy's Hospital; Assistant Surgeon to the Evelina Hospital for Sick Children.*

Cautery; Ecraseur; Stings of Insects; Bites of Venomous Serpents; Torsion of Arteries.

THOMPSON, SIR HENRY, *Surgeon Extraordinary to the King of the Belgians; Emeritus Professor of Clinical Surgery in University College, London; Consulting Surgeon to University College Hospital.*

Tumours of the Bladder.

THORNTON, JOHN KNOWSLEY, M.B., C.M., *Surgeon to the Samaritan Free Hospital for Women and Children.*

Abdominal Tumours; Diseases of the Broad Ligaments; Cæsarean Section; Diseases of the Fallopian Tubes; Laparo-Elytrotomy; Oöphorectomy; Ovarian Tumours; Ovariotomy; Porro's Operation; Diseases of the Spleen; Symphysiotomy; Uterine Tumours; Extirpation of the Uterus and Uterine Appendages.

TOMES, CHARLES SISSMORE, M.A., F.R.S.

Caries of the Teeth; Dentition; Extraction of Teeth; Gumboil; Teeth as a Test of Age; Toothache.

TREVES, FREDERICK, *Surgeon to, and Lecturer on Anatomy at, the London Hospital.*

Air in Veins; Artificial Anus; Intestinal Obstruction; Laparotomy for Intestinal Obstruction; Colectomy; Colotomy; Fæcal Abscess and Fæcal Fistula; Enterectomy; Enterotomy; Inflamed Hernia; Obstructed or Incarcerated Hernia; Strangulated Hernia; Articles on Femoral, Inguinal, and other Varieties of Hernia; Lymphadenitis; Lymphadenoma; Lymphangeiectasis; Lymphangitis; Lymphorrhœa; Injuries and Diseases of the Thoracic Duct.

TURNER, GEORGE ROBERTSON, *Visiting Surgeon to the Seamen's Hospital, Greenwich; Lecturer on Practical Surgery at St. George's Hospital.*

Gluteal Aneurism; Affections of the Gluteal Region; Ununited Fracture.

TWEEDY, JOHN, *Professor of Ophthalmic Medicine and Surgery at University College, and Assistant Ophthalmic Surgeon to University College Hospital; Surgeon to the Royal London Ophthalmic Hospital, Moorfields.*

Examination of the Cornea; Inflammation of the Cornea; Ulceration of the Cornea; Variations of Curvature in the Cornea; Injuries of the Cornea; Ectropion; Entropion; Diseases of the Eyelids; Injuries of the Eyelids; Hemeralopia; Herpes Frontalis; Diseases and Injuries of the Sclerotic.

WALSHAM, WILLIAM JOHNSON, C.M., *Assistant Surgeon to, and Demonstrator of Practical and Orthopædic Surgery at, St. Bartholomew's Hospital; Surgeon to the Metropolitan Free Hospital.*

Diseases of the Pharynx; Injuries of the Pharynx; Tumours of the Pharynx; Extirpation of the Pharynx; Pharyngeal Stenosis; Naso-pharyngeal Growths; Retro-nasal Catarrh; Affections of the Septum Narium; Rouge's Operation; Ulceration and Ulcers.

WILLETT, ALFRED, *Surgeon to St. Bartholomew's Hospital, and to St. Luke's Hospital.*

Tumours; Cystic Tumours; Erectile Tumours; Fibrous Tumours; Adenoma; Enchondroma, and other Special Articles on Varieties of Non-malignant Tumour.

WOOD, JOHN, F.R.S., *Professor of Clinical Surgery in King's College, London, and Surgeon to King's College Hospital.*

Ectopia Vesicæ and Epispadias; Hypospadias; Radical Cure of Hernia.

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